A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

DECEMBER, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

4735. α-Particle Model of the Nucleus. L. R. Hafstad and E. Teller. *Phys. Rev.* 54. *pp.* 681–692, *Nov.* 1, 1938.—This paper reviews the theory of nuclei composed of α-particles alone, and extends it to cases where in addition to the α-particles, a single neutron or proton is present, and also to those light nuclei in which a single neutron or proton is missing from the complete α-particle structure. In the latter cases the missing particle is considered as a neutron or proton "hole." In the first section of the paper, the configuration of the α-particles is considered together with the motion of the neutron, proton, neutron hole, or proton hole, in the field of the fixed α-particles for nuclei lighter than F. Rough values for the binding energies are obtained and compared with the results of the Hartree model. In the second section of the paper, rotations of the same nuclei are discussed, and the symmetry properties of the fundamental states, as well as the symmetry properties and the approximate spacing of some of the excited states are obtained. The symmetry properties of the fundamental states are in agreement with those obtained from the independent-particle model. Furthermore the excited states as obtained from the two models show a marked parallelism, although a greater number of levels is predicted by the α-particle model than by the independent-particle model. AUTHORS.

4736. Binding Energy of Li^6. H. Margenau and K. G. Carroll. *Phys. Rev.* 54. *pp.* 705–713, *Nov.* 1, 1938.—The mass defect of Li^6 has been calculated with the use of a symmetric Hamiltonian. Perturbation theory was employed in the main part of the work, and an upper limit for the contribution of all functions to the first and second-order perturbation energies was obtained. This upper limit is 10% smaller than the experimental binding energy. It was then shown on the basis of variational calculations that perturbation theory, carried to this stage, overshoots the mark, and the upper limit to the binding energy is reduced to 26 eMV, which is 6 eMV short of the experimental value. These figures are based on a set of nuclear constants which favour large mass defects. The perturbational effect of all doubly excited configurations upon the ^3D-state of Li^6 was investigated and compared with the effect of similar functions upon the ^3S-state. The result is that the first order $^3D - {}^3S$ splitting, which is about 2 eMV, is enlarged to 6 eMV, both levels being depressed. AUTHORS.

4737. Theory of Hydrogen Molecule. T. Inui. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 770–779, *Sept.*, 1938.—In this mathematical paper the treatment of the H_2 molecule by the Fock method is investigated, and a simple procedure developed which admits of the description of the electronic states of molecules in terms of orbitals. H. H. Ho.

4738. Structure of PCl_5. M. Rouault. *Comptes Rendus*, 207. *pp.* 620–622, *Oct.* 10, 1938.—Electron diffraction measurements of PCl_5

vapour at 100° agree with the assumption that the molecule of PCl_5 is a trigonal bipyramid with P in the centre, three atoms of Cl in the same plane therewith at distances l_1, and two at the summits of the pyramids at distances l_2: $l_2/l_1=1\cdot07$, which assuming $l_1=2\cdot10$ Å and $l_2=2\cdot25$ Å gives 3·08 Å as the minimum distance between two atoms of Cl. [See Abstract 1344 (1936).] C. A. S.

4739. Structures of S, V and Cr Compounds. K. J. Palmer. *Am. Chem. Soc., J.* 60. *pp.* 2360–2369, *Oct.*, 1938.—The molecular structures of SCl, SCl_2, $SOCl_2$, SO_2Cl_2, SO_3, $VOCl_3$, and CrO_2Cl_2 have been investigated by the electron diffraction method. The final values of the interatomic distances and angles are given. It has been shown that SO_2Cl_2, $VOCl_3$ and CrO_2Cl_2 have tetrahedral configurations which are, however, considerably distorted. $SOCl_2$ is pyramidal, and SO_3 planar. SCl has been shown to have one Cl atom attached to each S atom. The positions of the Cl atoms cannot be determined with certainty. AUTHOR.

4740. Structures of Hexacarbonyls of Cr, Mo and W. L. O. Brockway, R. V. G. Ewens and M. W. Lister. *Faraday Soc., Trans.* 34. *pp.* 1350–1357, *Nov.*, 1938.—The molecular structures of Cr, Mo and W hexacarbonyls have been investigated by the method of electron diffraction by the vapour. The most probable molecular model is represented by a regular octahedron with the metal atom at the centre and the six CO groups directed towards the apices. It is assumed that the CO groups are attached to the metal atom through the C atoms. The Cr-C bond length, 1·92 ± 0·04 Å, is about 0·08 Å greater than in the corresponding bonds of Fe and Co nitrosyl carbonyls and Ni carbonyl. Since these molecules are isoelectronic with the Cr carbonyl, the greater distance in the latter is evidently related to the greater number of groups attached to the Cr atom. The Mo-C and W-C bond lengths are 2·08 ± 0·04 Å and 2·06 ± 0·04 A. AUTHORS.

4741. Structures of $MoCl_5$ and WCl_6. R. V. G. Ewens and M. W. Lister. *Faraday Soc., Trans.* 34. *pp.* 1358–1362, *Nov.*, 1938.—The structures of $MoCl_5$ and WCl_6 have been investigated by electron diffraction of the vapours. $MoCl_5$ is a trigonal bipyramid, with $Mo—Cl=2\cdot27\pm0\cdot02$ Å and WCl_6 is a regular octahedron with $W—Cl=2\cdot26\pm0\cdot02$Å. AUTHORS.

4742. Atomic Distribution in Allotropic Forms of Phosphorus at Different Temperatures. C. D. Thomas and N. S. Gingrich. *J. Chem. Phys.* 6. *pp.* 659–665, *Nov.*, 1938.—Monochromatic X-ray diffraction patterns of liquid yellow, amorphous red and amorphous black P were obtained, using Mo Kα radiation. The effect of temperature upon these patterns was investigated for the first two forms. Analysis of these patterns led to the determination of the atomic distribution curves in each case. The number of nearest neighbours is three for all forms. This is taken as direct proof of the existence of P_4 molecules in liquid yellow P. Comparisons are made of the atomic distribution curves of each form and at the different temperatures for liquid yellow and amorphous red P. AUTHORS.

See also Abstracts 4903, 4924, 4956, 4957.

COLLOIDS.

4743. Formation of Gold Sols in Alkaline Solutions. L. L. Bircumshaw. *Faraday Soc., Trans.* 34. *pp.* 1236–1239, *Oct.*, 1938.—For the immediate production of a red gold sol by the reduction of an alkaline solution of gold by formaldehyde it appears to be necessary that the *whole* of the gold should be present in the solution as aurate. AUTHOR.

4744. Production of Aerosols by Spraying Solutions. G. Jander and E. Wygasch. *Kolloid Zeits.* 85. *pp.* 1–8, *Oct.*, 1938.—The production of aerosols by the spraying of solutions of KI was investigated. It was found that the aerosols were reproducible, that the average mass of the particles was a function of the concentration of the solution, and that the initial concentration of the cloud varied with the volume of solution dispersed. The range of sizes present in a given cloud was large and increased with increasing concentration of the solution, while a corresponding decrease in the stability was observed. [See also Abstract 23 (1937).] W. H. Wal.

4745. Influence of Dispersity on Dynamic Birefringence of Colloids. C. Sadron. *J. de Physique et le Radium*, 9. *pp.* 381–383, *Sept.*, 1938.—Results previously obtained for monodisperse media [see Abstract 911 (1938)] are now generalised to cover solutions containing particles of differing shapes. General formulæ are obtained giving the position of the neutral lines and the birefringence of such a medium. The theory is tested numerically in the case of two components, and it is shown how different the variation of the position of the neutral lines as a function of velocity gradient can be from that observed in monodisperse systems. [See following Abstract.] C. B. A.

4746. Dynamic Birefringence of Polydisperse Systems. C. Sadron and H. Mosimann. *J. de Physique et le Radium*, 9. *pp.* 384–386, *Sept.*, 1938.—Curves of dynamic birefringence are given for a number of polydisperse media. The results agree with those calculated [see preceding Abstract] so that this method indicates rapidly whether a colloidal system is polydisperse or not. Measurements made with a fractionated nitrocellulose show that the small residual polydispersity is sufficient to cause an appreciable perturbation at large values of velocity gradient. C. B. A.

4747. Stretching of Heated Polystyrene Films. G. van Iterson Jr. and K. E. C. Buyn. *Kolloid Zeits.* 85. *pp.* 60–70, *Oct.*, 1938.—Strips of polystyrene cut along and perpendicular to the direction of rolling were heated above 90°C. under various loads. The strips shortened or stretched, and sometimes stretching succeeded shortening. Double refraction was measured before and after heating. A theoretical explanation of the more important phenomena is given, based on the Fransen theory and on a kinetic theory. P. H. B.

4748. States of Dust. O. Brandt. *Kolloid Zeits.* 85. *pp.* 24–32, *Oct.*, 1938.—The author describes three states in which dust may exist, (1) suspended in a gas (schwebezustand), $k=1$; (2) as a self-supporting structure with no part of the weight carried by the gas (lagerzustand), $k=0$; (3) in a state of flow in which part of the weight of the dust is borne by the gas (fliesszustand), $0<k<1$. These states are defined by the value of the flow-factor (k), the fraction of the total weight of dust which is carried by the gas. An account is given of an experimental investigation of states (2) and (3). W. H. Wal.

4749. Constant of Sedimentation by Ultracentrifuge. M. Paić. *Comptes Rendus*, 207. *pp.* 629–632, *Oct.* 10, 1938.—If the concentrations of a solution before and after centrifuging, and the mode of the centrifuging, be known, the constant of sedimentation may be calculated. In general, the mode of centrifuging is ill-defined. The uncertainty arising from

this cause may be avoided by determining the relative value of the constant of sedimentation by comparison with a second substance.
W. H. Wal.

4750. Kataphoresis and Sedimentation Potential. J. J. Hermans. *Phil. Mag.* 26. *pp.* 650–674, *Nov.*, 1938.—When charged spherical particles move in an electrolytic solution the double layer is deformed. The theory of this phenomenon can be developed if the double layer is very thin as compared with the radius of the particle. This is worked out for the motion under the influence of an external electric field (kataphoresis), and for a motion in the absence of an external electric field (sedimentation potential). The final formula for the kataphoretic velocity shows (1) that maxima may occur in the kataphoretic velocity with continually increasing absolute value of the ζ-potential ; (2) that the charge of the particles as calculated from the kataphoretic velocity will not as a rule tally with the charge determined by direct means, particularly if the particle is a conductor ; (3) that the electroosmotic and kataphoretic velocities will only be the same in special cases, and then only approximately. From the formula for the sedimentation potential it can be concluded that sedimentation potentials of some 10mV may occur when large particles fall down in distilled water under the influence of gravitation. The formula may be applied to study the process of sedimentation, and may sometimes be useful to compute the ζ-potential of large particles where no measurement of kataphoretic velocity is possible. Finally, it may be added that the distortion of the double layer will contribute to the dielectric constant of the systems considered. The sign of this contribution will to a large extent depend on the sign of $\zeta\Sigma n_k e_k^3$. The author hopes to deal later with this problem in more detail. AUTHOR.

4751. Charged Colloid Particles in an Ultrasonic Field. Part II. J. J. Hermans. *Phil. Mag.* 26. *pp.* 674–683, *Nov.*, 1938.—A plane sonic wave is assumed to move in a suspension of spherical particles. These particles lagging behind the solvent, their double layer is deformed, and a dipolar moment is set up. Summing up these dipolar moments for all the particles, and integrating for a quarter of the sonic wave, the p.d. ϕ between a node and an antinode is found. The diffuse double layer round the particles is assumed to be thin as compared with their radius. It is found that the value of ϕ is maximum in the special case—interesting from both a hydrodynamical and a colloid-chemical point of view—where the flow of liquid round the particle becomes different from that of uniform motion, a phenomenon which is due to the inertia of the liquid. In this case the p.d. ϕ may amount to the remarkably high value of some volts. Measurements of ϕ may lead to a better understanding of the nature of many suspensions of colloidal solutions and their behaviour in a sonic field. Moreover, the effect may sometimes be useful to determine the ζ-potential of particles which are too large to enable a determination of kataphoretic mobility. [For Part I see Abstract 1388 (1938).] AUTHOR.

4752. X-Ray Diffraction Studies on Heavy-Metal Ferrocyanide Gels. H. B. Weiser, W. O. Milligan, and J. B. Bates. *J. Phys. Chem.* 42. *pp.* 945–954, *Oct.*, 1938.—Gels of heavy-metal ferrocyanides carry down much alkali ferrocyanide. $Cu_2Fe(CN)_6$ precipitated in the presence of excess Cu is practically pure and gives a definite X-ray diffraction pattern. When precipitated with excess $K_4Fe(CN)_6$ the diagram is unaltered although the gel may have adsorbed considerable quantities of $K_4Fe(CN)_6$. The adsorbed ferrocyanide is thus not in the form of a double salt. Cu, Co, Ni, and Mn ferrocyanides are isomorphous and have almost identical lattice constants. With Zn, Cd, and Ag ferrocyanides a double salt is formed with $K_4Fe(CN)_6$ in each case. A. J. M.

4753. Hydrous Oxide Hydrosols and Gels. A. Ganguli. *Acta Physicochimica*, 9. 1. *pp.* 197–201, 1938. *In English.*—Freshly prepared sols and gels of hydrous oxides are truly amorphous. In accordance with the views of the author [see Abstracts 1476 and 3354 (1937)] on the amorphous state these consist of long-chain complexes. During the course of ageing and desiccation the amorphous bodies pass to the polycrystalline and finally to the crystalline forms. The thixotropy, gelation and high viscosity of these sols, the swelling of gels and the X-ray patterns are explained on the above view. AUTHOR.

See also Abstracts 4773, 4832, 4999.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

4754. Crystallographic Radii. H. Jensen, G. Meyer-Gossler and H. Rohde. *Zeits. f. Physik*, 110. 5–6. *pp.* 277–290, 1938.—There exists a definite relationship between the lattice constants of ionic crystals. The lattice spacing is formed by the placing together of the individual ions, *i.e.* a definite radius can be assigned to an ion, which is independent of the type of binding. The lattice constant is thus the sum of the ionic radii. The physical significance of these concepts is established by a quantum-mechanical treatment. The calculations show that the radius of an ion is independent of its neighbours and that the additive law holds. The computed radii lie close to the Goldschmidt values. A numerical solution of the Fermi equation is given in an appendix. C. J. B. C.

4755. Classification of Solids. W. Nowacki. *Zeits. f. Krist.* 100. 1. *pp.* 77–81, 1938.—Strock [see Abstract 1420 (1936)] has given a classification of solid bodies, but there are several unsatisfactory features in his treatment, *e.g.*, in dealing with lattices with rotating atom groups. A classification is now given which will represent all the yet known cases and deviations from mathematical structure theory. C. J. B. C.

4756. Graphical Representation of the Possibilities of Rotation Axis Combinations. H. Tertsch. *Zeits. f. Krist.* 100. 1. *pp.* 85–90, 1938.—Rotation axes have been discussed in a previous publication [see Abstract 28 (1938)]. Combinations of two-, three-, four- and six-fold rotation axes are discussed and represented graphically. C. J. B. C.

4757. Vector Maps and Crystal Analysis. I. Langmuir and D. Wrinch. *Nature*, 142. *pp.* 581–583, *Sept.* 24, 1938.—The authors discuss, from a geometrical standpoint, the construction of vector maps from distributions of point intensities giving examples showing how the expressions derived are applied in turn to 1,- 2- and 3-dimensional crystals. The illustrations show that by this method of interpreting vector maps it is possible to deduce details of the structure of the insulin molecule. J. I.

4758. Potential Energies of Alkali Halides—Errata and Extension of the Semi-Empirical Formula. A. May. *Phys. Rev.* 54. *pp.* 629–633, *Oct.* 15, 1938.—A correction is first made of the author's previous calculations for CsCl [see Abstract 3834 (1937)], in which an incorrect empirical value was used. By extending the method of Born and Mayer, six constants in the potential energy expression for CsCl are evaluated from available measurements on the lattice and vapour. The results so obtained are then applied to other alkali halides, and permit the determination of the interionic distances in the gas, the lattice energies and heats of sublimation. The agreement with empirical data is satisfactory for the interionic distances, but is otherwise poor. AUTHOR.

4759. Diffraction of X-Rays by an Age-Hardening Cu-Al Alloy. G. D. Preston. *Roy. Soc., Proc.* 167*A*. *pp.* 526–538, *Sept.* 23, 1938.—A 4 % Cu alloy is synthesised from high purity metals, drawn to 1 mm. wire, and annealed at 500° C.; the 2-5 mm. crystals which it contains after this treatment being examined by oscillating crystal and Laue methods, with hot kathode Cu radiation at 40 kV (r.m.s.), 10-15 mA, and exposures of 1-1½ hr. Age hardening for 26 days at 150° C. or 10 hr. at 200° C. is associated with segregation of Cu atoms on (100) planes as suggested by Desch in 1934. On ageing at 200° C. for 10 hr. one satellite disappears, an intermediate phase being then present in the alloy. It is difficult to say whether the crystal is now single-phase or duplex, but at earlier stages the Cu atoms are still in substitutional solid solution in the Cu lattice. Where it is segregating it is not present in sufficient quantity to give a CuAl precipitate, and the alloy seems to resemble the Fe-Ni-Al alloys of high coerciveness described by Bradley and Taylor. ["Magnetism", Lecture VI, *p.* 91. *Institute of Physics.* 1938.] D. R. H.

4760. Structure of Fe-Pd Superlattices. R. Hultgren and C. A. Zapffe. *Zeits. f. Krist.* 99. 6. *pp.* 509–512, 1938.—FePd and $FePd_3$ are studied by means of powder photographs. When quenched from above 700° C. FePd has a "disordered" cubic structure. Quenched from 650° C. or below the structure is tetragonal and "ordered". $FePd_3$ can also exist in the "ordered" and "disordered" states but remains cubic. For both FePd and $FePd_3$ ordering is accompanied by an increase in the volume of the unit cell. J. T.

4761. X-Ray Test of Superstructure in $FeNi_3$. F. E. Haworth. *Phys. Rev.* 54. *pp.* 693–698, *Nov.* 1, 1938.—A search has been made for superstructure in permalloy of composition near $FeNi_3$. Curves of X-ray scattering power near the absorption edges of Ni and Fe show that Fe $K\beta$-radiation should give the strongest superstructure lines, and calculations indicate that reflection from (321) planes of a perfectly ordered structure should have about one-seventh the intensity of the ordinary (222) reflection. The specimen was a powdered alloy containing 70% nickel, annealed at 1000° C. and baked at 425° C. It was placed in a focusing camera in a beam of Fe $K\beta$-rays which were selected and concentrated by a curved rock-salt crystal, and exposed for 100 hr. No superstructure lines appeared, although superstructure in β-brass was easily detected with similar technique. This negative result, which is supported by a considerable amount of indirect evidence, indicates that no long range order exists in $FeNi_3$. AUTHOR.

4762. Structure of Aliphatic Compounds: n-$C_{30}H_{62}$. R. Kohlhaas and K. H. Soremba. *Zeits. f. Krist.* 100. 1. *pp.* 47–57, 1938.—The preparation of the n-paraffin $C_{30}H_{62}$ is described. Single crystals are obtained, and investigated by means of the rotating crystal method. They are orthorhombic with $a = 7{\cdot}452$, $b = 4{\cdot}965$, $c = 81{\cdot}60$ Å; density $= 0{\cdot}939$; 4 mol. per unit cell; space-group $= D_{2h}^{16}$. The following molecular dimensions are given, distance between C-atoms in direction of chain = 1·26 Å, diameter of C-atom = 1·57 Å, angle between adjacent C-atoms = 106·0°. The chains lie in the (110) plane and the distance between consecutive molecules is 4·2 Å, while the smallest distance between neighbouring CH_2 groups is 2 Å. The structure is discussed in relation to that of other paraffins. J. I.

4763. X-Ray Analysis of Structure of Water. J. Morgan and B. E. Warren. *J. Chem. Phys.* 6. *pp.* 666–673, *Nov.*, 1938.—X-ray diffraction patterns of water were obtained at five temperatures: 1·5°, 13°, 30°, 62°, and 83° C. The radiation was Cu Kα and Mo Kα, monochromated by reflection from a rock-salt crystal. Radial distribution curves for water at the five temperatures were obtained by a Fourier analysis of the X-ray intensity curves. The first peak is only partially resolved, and it is not possible to interpret the distribution curves uniquely in terms of a definite number of neighbours at definite distances. The results can be interpreted in terms of a structure in which the tendency of a water molecule to bond itself tetrahedrally to four neighbouring molecules is only partially satisfied. AUTHORS.

4764. Structure of Nematic Layers. H. Zocher and G. Ungar. *Zeits. f. Physik*, 110. 9–10. *pp.* 529–548, 1938.—The interference figures in parallel polarised light afforded by the homogeneous regions of nematic layers of thicknesses up to 1 mm. have been observed and partly photographed in convergent polarised light. The curves obtained for two kinds of simply deformed zones are found to correspond with those derived from the Oseen differential equations and the assumed boundary conditions. It is established by the quantitative evaluation of the interference figures from homotropic regions of *p*-acetoxybenzalazin in layers up to 1 mm. thickness, that the parallel orientation of molecules, even in layers of such thickness, extends throughout the whole of the layer from one boundary surface to the other, and is not restricted to thin marginal layers as assumed in the swarm theory. The paper is replete with experimental details and illustrations. H. H. Ho.

4765. Polymorphic Transformation of Mercuric Iodide. D. G. Eade and N. H. Hartshorne. *Chem. Soc., J. pp.* 1636–1646, *Oct.*, 1938. —The paper describes the results of direct measurements of the linear rate of movement of the interface between red and yellow HgI_2 in thin polycrystalline films. From 0° to 40° (yellow → red), where the transformation is directed towards the denser form, the interface starts preferentially at the edges of the film and the rate shows a decline with time at constant temperature, given very nearly by the equation $t = k_1s^2 + k_2s$, where s is the linear distance moved by the interface in time t, and k_1 and k_2 are constants. The apparent energy of activation between 0° and 30° is of the order of 10000–11000 cal., which is very much less than the internal latent heats of sublimation of the two forms, which are of the orders 22000 (red) and 19000 (yellow) cal. The rate when $s = 0$ is about 1000 times greater than that calculated on the assumption that it is governed by the difference between the rates of evaporation of the two forms into a vacuum. At 130° (red → yellow) the reaction occurs mainly by the growth of nuclei of the yellow form in the interior of the film. In unannealed films, the linear rate shows a strong decline, owing presumably to the presence of cracks and possibly also to the loss of material from these cracks by evaporation. In annealed films, sealed to prevent evaporation, the rate is roughly constant in the early stages, but when the process is followed for a sufficient distance, the s–t curve is sigmoid in shape. The rate varies considerably from film to film. AUTHORS.

4766. Growth of Large Crystals of Potassium Bromide. K. Chamberlain. *Rev. Sci. Instruments*, 9. *pp.* 322–324, *Oct.*, 1938.—

Details are given regarding the construction of a suitable furnace, and of the method adopted for the production of large crystals of KBr, up to 5 in. in dia. and weighing 6–7 lb., in 12 hr. C. A. S.

4767. Crystal Growth of NaCl. K. Spangenberg. *Zeits. f. Krist.* 100. 1. *pp.* 82–85, 1938.—The growth of NaCl crystals is studied under carefully controlled conditions, the temperature being kept constant to ± 0·001° C. The observations indicate that there are two types of crystals, the characteristics of which are described. C. J. B. C.

See also Abstracts 4753, 4771, 4942, 4982, 4999, 5061 and 3367B. Graphical Representation of the Lever Law in Heterogeneous Equilibria. R. Bertschinger.

DENSITY.

4768. Density of Glass by the Additive Rule. P. Bary and J. Herbert. *Comptes Rendus*, 207. *pp.* 627–629, *Oct.* 10, 1938.—The rule of addition of volumes applied to the components of a glass leads to a value for the density which may be in error by 15%. On the hypothesis that glass may be considered as a gel composed of alkaline silicates dissolved in polysilicates of alkaline-earths, it is concluded that the silica is present in two forms. On assigning to each of these its correct density, it is found that the calculated densities of various glasses agree with the measured values to within about 1%. For glasses containing a large proportion of alumina it is found necessary to assume the density of the alumina to be 2·60, and it is concluded that the alumina is present as aluminium silicate and not in the colloidal state. W. H. Wal.

See also Abstracts 4820, 4931.

DIFFUSION AND OSMOSIS.

4769. Diffusion of He and H_2 through Pyrex Glass. N. W. Taylor and W. Rast. *J. Chem. Phys.* 6. *pp.* 612–619, *Oct.*, 1938.—The effects of temperature and of heat treatment on pyrex glass were studied by measuring the rate of diffusion of He at 180° to 590° and of H_2 at 512° through a tube of about 1 mm. wall thickness. The diffusion rate was found to be proportional to the pressure for both gases. A discussion of diffusion data throws light on the processes of molecular rearrangement involved in stabilisation of the glass. A continuous linear dependence for the stabilised glass of log R (diffusion rate) on $1/T$ from 440° to 590° is shown, and it follows that the properties of a stabilised glass are continuous with those of a viscous liquid, the so-called transformation point being merely the temperature of rapid strain release of an unannealed sample. Near 440° there is evidence of the loss of rotational or vibrational freedom in the silicate complex, analogous to that frequently found in dielectric studies on solids. Activation energies are calculated for the two temperature ranges. At 512° the rate of He diffusion is about 45 times that of H_2, and it is believed that chemical forces delay the progress of the H_2 molecule through the silicate network. The general conclusion is drawn that gas diffusion furnishes a highly senstive method of studying the molecular condition of silicate glasses and similar materials. N. M. B.

4770. Interpretation of Diffusion Data for Strong Electrolytes. P. van Rysselberghe. *Am. Chem. Soc., J.* 60 *pp.* 2326–2331, *Oct.*, 1938.—The diffusion mobilities of KCl, NaCl and KNO_3 in aqueous solution are calculated from the experimental diffusion coefficients and the thermodynamic factors $1+C\partial \log f / \partial C$. The diffusion mobilities are com-

pared with theoretical values obtained in three different manners: (*a*) by means of the Onsager-Fuoss theory of diffusion; (*b*) by applying the simple viscosity correction to the mobility at infinite dilution; (*c*) by applying the viscosity correction to the Onsager-Fuoss mobilities. It is shown that the viscosity correction is at least as important as the Onsager-Fuoss interionic effects and that, with sodium chloride, the correct sign for the variation of the mobility cannot be obtained without the viscosity correction. Remarks are made concerning the minima in the diffusion and activity-coefficient curves and concerning the diffusion of sucrose. A modified form of the Stokes-Einstein law of diffusion is proposed.
AUTHOR.

4771. Diffusion of Water in Crystals. H. Kraft. *Zeits. f. Physik*, 110. 5–6. *pp*. 303–309, 1938.—The diffusion of water in a crystal having water of crystallisation is measured. The method of experimenting is to allow D_2O to diffuse into crystals which have H_2O of crystallisation, and to measure the D_2O content spectroscopically. The diffusion coefficient is very small; $1\cdot0 \times 10^{-11}$ cm.^{2}/sec. at 75°C, $7\cdot5 \times 10^{-12}$ at 65°C. and $5\cdot9 \times 10^{-12}$ at 55°C. in alum. From the temperature coefficient of the diffusion speed the activation energy is calculated as 6000 cal.
C. J. B. C.

***4772. Porous Diaphragm Method of Measuring Diffusion Velocity, and Velocity of Diffusion of KCl in Water. G. S. Hartley and D. F. Runnicles.** *Roy. Soc., Proc.* 168A. *pp*. 401–419, *Nov*. 7, 1938.—A continuous reading apparatus for measuring the rates of diffusion of pure electrolytes through porous diaphragms is described. Data obtained for the diffusion of KCl as a function of concentration are presented and the absolute values obtained by extrapolation. The comparison of the results obtained with the best available data by absolute measurements shows that there is still room for more accurate work in the whole problem, but it is believed that the diffusion coefficients in the range from $N/100$ to $N/10$ are accurate to within 2%. [See following Abstract.]
AUTHORS.

4773. Size of Paraffin-Chain Salt Micelles from Diffusion Measurements. G. S. Hartley and D. F. Runnicles. *Roy. Soc., Proc.* 168A. *pp*. 420–440, *Nov*. 7, 1938.—The porous diaphragm method has been applied to the measurement of the diffusion of paraffin-chain micelles in aqueous solution with a swamping excess of simple electrolyte. For cetyl pyridinium salts the method is satisfactory and a radius for the micelle of about 26 Å is found. The radius is independent, within experimental error, of the concentration of paraffin chain or swamping electrolyte, and very little dependent on temperature. These results are in excellent agreement with the "spherical liquid micelle" theory. There is small, but definite, influence of the nature of the gegenion on the size of the micelle. For cetane sulphonates and cetyl sulphates the method fails to give reliable results, probably owing to the building up of a structure within the pores of the diaphragm. When the solutions are saturated with amyl alcohol or benzene the method again fails to give reliable results. A mechanism is suggested for the anomalies observed. [See preceding Abstract.]
AUTHORS.

4774. Boundary Layer at Membrane and Monolayer Interfaces. J. H. Schulman and T. Teorell. *Faraday Soc., Trans.* 34. *pp*. 1337–1341, *Nov*., 1938.—By a new technique of flowing monolayers over aqueous solutions of different viscosities, an apparent boundary layer of 0·03 mm.

thick was determined. The thickness of this layer varied with the viscosity of the underlying solution, but contrary to experience at discrete boundaries the thickness did not vary with the velocity of the monolayer. An explanation was offered for this phenomenon in that the molecular density of the film alters with its velocity such that the number of molecules per unit area × the rate of flow remained constant. By application of Fick's diffusion equation for H- ions diffusing through cellophane membranes in a stirred solution, an apparent unstirred boundary layer of similar dimensions of 0·03 mm. with the proceeding experiment was obtained. The effect of unstirred diffusion layers was eliminated by buffering the H- ions by means of gelatin immediately upon their leaving the membrane. The importance of unstirred boundary layers when considering diffusion in biological systems is pointed out. AUTHORS.

See also Abstract 4994.

ELASTICITY AND PLASTICITY.

4775. Finite Strains : Dislocation Solutions. S. T. Newing and W. M. Shepherd. *Phil. Mag.* 26. *pp.* 557–569, *Oct.*, 1938.—A mathematical study of the consequences of the distortion of a uniform circular cylindrical sheet of elastic material for two cases, (1) in which a longitudinal strip is removed, and the edges then brought together, and (2) in which a longitudinal cut is made, and the edges forced apart. In a detailed analysis of a special instance of (1) it is found that according to the finite strain theory used in this paper [see Abstract 3452 (1936)] the couple required to produce a given decrease in the curvature of an already curved plate is less than that deduced from the small strain theory. J. P. A.

4776. Relaxation Methods Applied to Engineering Problems. Part III. Problems Involving Two Independent Variables. D. G. Christopherson and R. V. Southwell. *Roy. Soc., Proc.* 168A. *pp.* 317–350, *Nov.* 7, 1938.—In this paper relaxation methods are applied with success to four problems involving Laplace's, Poisson's and similar equations in *two variables*, namely : The torsion problem of Saint-Venant for triangular shafts (this, since the solution is known, serves to illustrate and in some degree to test the methods) ; the same problem for a shaft pierced by axial holes (a multiply-connected cross-section) ; the torsion problem modified by the imposition of a definite limit to the shear stress (Prandtl's problem) ; the problem of magnetic induction in a field containing iron. In all four problems the methods lead without difficulty to solutions of sufficient accuracy for practical purposes, and it seems reasonable to conclude that they will be applicable (suitably modified) to other problems which, like the last three, would present great or insuperable difficulties if treated by orthodox methods. [For Part II see Abstract 946 (1938).] AUTHORS.

4777. Stresses in a Heavy Disc Suspended from an Eccentric Peg. R. D. Mindlin. *J. of Applied Physics*, 9. *pp.* 714–717, *Nov.*, 1938. *Phil. Mag.* 26. *pp.* 713–719, *Nov.*, 1938.—An exact solution of the two-dimensional elasticity equations for small strain is obtained which satisfies the boundary conditions for a heavy disc suspended in a vertical plane from an eccentric peg of small diameter. AUTHOR.

***4778. Standard Discs in Strain Testing of Glassware. E. J. Gooding.** *Soc. Glass Technol. J.* 22. *pp.* 243–249, *Aug.*, 1938.—By comparison with standard glass discs strained to a controlled amount glassware has been graded for degree of temper. The methods used in the preparation, calibration, and use of the discs are described and their usefulness assessed. AUTHOR.

4779. Dependence of Mechanical Strength of Quartz Glass on Temperature. W. Dawihl and W. Rix. *Zeits. f. techn. Physik*, 19. 10. *pp.* 294–296, 1938.—Measurements of the strength of quartz rods and of hollow specimens made from quartz glass show that the resistance of quartz glass to mechanical stress is a third greater at 800°C. than at room-temperature. The formation of mirror faces at each temperature is in agreement with the views of Smekal. J. T.

See also Abstracts 4792, 4829, 4974 and
3620B. Damping of Forced Oscillations. E. Lehr and A. Weigand.

GRAVITATION.

***4780. Precise Measurement of "g." A. Guillet.** *Comptes Rendus*, 207. *pp.* 614–616, *Oct.* 10, 1938.—A Newton tube is used in which a weight is released by an electromagnet and falls vertically. The time employed in falling to a lower level is determined either by electrical recording or by a camera falling at the same time as the weight and photographing it against a scale. The distance between the two fixed points is determined by means of a comparator. Pressure and temperature in the tube are measured. The degree of accuracy for different times and distances is very high. R. S. R.

HYDRODYNAMICS AND AERODYNAMICS.

4781. Approximate Prediction of Skin Friction and Lift. N. A. V. Piercy, J. H. Preston and L. G. Whitehead. *Phil. Mag.* 26. *pp.* 791–815, *Nov.*, 1938. *Supplement.*—[See also Abstract 2541 (1936).]

4782. Mean Value of Fluctuations in Pressure and Pressure-Gradient in a Turbulent Fluid. A. E. Green. *Cambridge Phil. Soc., Proc.* 34. *pp.* 534–539, *Oct.*, 1938.—Taylor has shown that two characteristic lengths, λ and λ_η can be defined for turbulent fluid motion [see Abstract 4101 (1935)] such that $\lambda^2/\lambda_\eta^2 = 9\beta^2/2$, where β is a constant, the turbulence being assumed to be isotropic. He obtained a value 0·694 for λ_η/λ, which he compared with an observed value $\lambda_\eta/\lambda = 0{\cdot}5$ [see Abstract 3996 (1936)]. Hall has recently obtained an experimental value 1·6 for λ_η/λ. Considering four fairly simple representations of motions which may be regarded as approximations to isotropic motions, the author deduces theoretical values of λ_η/λ ranging from 0·86 to 1·02. J. S. G. T.

4783. Oscillatory Motion of a Fluid along a Circular Tube. D. G. Christopherson, A. Gemant, A. H. A. Hogg and R. V. Southwell. *Roy. Soc., Proc.* 168*A*. *pp.* 351–378, *Nov.* 7, 1938.—This paper is concerned with oscillatory motion (either free or forced) of a viscous fluid along a circular tube: the restoring force comes in both instances from the "gravity head" which results from the passage of fluid. Part I is a theoretical discussion of the problem. Part II deals from a practical standpoint with complicating factors (*e.g.*, turbulence, or meniscus and other end effects) which the theory does not take into account, and briefly discusses a possible application to viscometry. Part III gives the results of experiments made to test the predictions of Parts I and II. AUTHORS.

See also Abstracts 4787, 4803.

KINETIC THEORY OF MATTER.

See Abstract 4994.

LENGTH, AREA AND VOLUME.

***4784. Deformation of Sensitive Levers. Berndt and W. Vogt.** *Zeits. f. Instrumentenk.* 58. *pp.* 389–408, *Oct.*, 1938.—The authors discuss the deformations which tend to falsify the measurements made with various types of lever. Such deformations are principally of three kinds: (1) Hooke's law compression due to forces uniformly distributed over the cross-section; (2) Hertzian flattening of curved surfaces; (3) Bending, resulting in variation of the distance from the support. These effects are thoroughly investigated for six different types of levers comprising (*a*) simple optical lever, (*b*) simple mechanical lever, (*c*) double mechanical lever with one lever working on another, (*d*) double mechanical lever with one lever working on a geared drive, (*e*) meter mechanism with spur-wheel or worm and wheel drive, (*f*) torsion and electric levers. The results obtained are tabulated and discussed. A. W.

***4785. Curved Rulers. F. Emde.** *Zeits. f. Instrumentenk.* 58. *pp.* 409–411, *Oct.*, 1938.—With curves of slowly varying curvature a useful method of representation is a series of circular arcs, since at any point a fairly long portion of the curve nearly coincides with an arc of a circle of some definite radius. When the curvature varies rapidly, a knowledge is required of the radii of curvature at a series of points along the curve, together with the rate of change of the radius. Assuming, as is usually the case, that only the convex edge of the ruler is used and that the radius continually increases, a spiral of some sort is obtained. It appears very desirable that this should conform to some simple equation. Typical forms are the logarithmic spiral and Cornu's spiral. The properties of these are briefly discussed and three illustrations are given of curved rulers based on what is called the "sici" spiral. A point on this curve is defined by the relation $x + iy = -\mathrm{L}\int_{\varrho}^{\infty} \frac{e^{i\varrho}}{\phi}\, d\phi = \mathrm{L}\,\mathrm{ci}\,\phi + i\,\mathrm{L}\,\mathrm{si}\,\phi$, where the functions ci and si denote the integral cosine and integral sine respectively. The values of these functions can readily be obtained from Jahnke-Emde tables and hence curves of any required length and curvature variation can quickly be drawn, using the relations $\phi = \mathrm{L}/\mathrm{R}$, $x = \mathrm{L}\,\mathrm{ci}\,\phi$ and $y = \mathrm{L}\,\mathrm{si}\,\phi$. Such curves have been in use for a considerable time and have proved extremely useful. A. W.

***4786. Calibration of Circular Scales from Eccentricity Measurements. W. Krug.** *Zeits. f. Instrumentenk.* 58. *pp.* 412–416, *Oct.*, 1938.—Comparison of results obtained using Uhink's method of eccentricity measurements with those given by Förster's method shows that the eccentricity method gives in practice curves which are sufficiently accurate to determine considerable errors in circular division. A. W.

***4787. Differential Pneumatic Micrometer. G. Ribaud.** *Comptes Rendus*, 207. *pp.* 618–619, *Oct.* 10, 1938.—Describes a modification of the pneumatic micrometer, used in the control of orifices for flow measurement, in which the differential principle is applied in order to increase the sensitivity and precision. This allows the instrument to be used for measuring variations of thickness, or even small displacements down to less than

$0 \cdot 1\mu$. It is pointed out that the principle employed has certain analogies with that of the Wheatstone bridge. H. B.

See also Abstract 5044 and
3426B. Elongation Measuring Apparatus. A. Thum, O. Svenson and H. Weiss.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

4788. Functions of Quaternions. V. C. A. Ferraro. *Roy. Irish Acad., Proc.* 44. *pp.* 101–108, *Jan.*, 1938.

4789. Method of Calculating Fluctuations. R. Ellickson. *Phys. Rev.* 54. *pp.* 572–579, *Oct.* 15, 1938.—A general method for the solution of fluctuation problems is described. A generating function for the differential equations that are satisfied by the probabilities in question is defined and the problem is reduced to the determination of the generating function. The general method for its determination is given and the results are applied to fluctuation problems in pair-production and radioactive disintegration. The method of finding the mean, mean square, and standard deviation from the generating function without reference to the form of the distribution itself is applied to the examples. The problem of fluctuations in chain and branch radioactive disintegrations is solved without restrictions on the size of the disintegration constants involved. AUTHOR.

4790. Problem in Coin-Tosses. S. R. Savur. *Phys. Soc., Proc.* 50. *pp.* 947–954, *Disc.*, 954–960, *Nov.* 1, 1938.—The paper discusses data given by Campbell [see Abstract 3768 (1935)] on the tossing of a coin, and questions his conclusion that the particular series quoted does not define a chance. A theoretical investigation is made of the limits within which the heads-to-tails ratio obtained by tossing a coin a given number of times may be expected to diverge from unity, and a practical study of the drawing of coloured balls from a container is described. The conclusion reached is that the ratio obtained in practice converges toward the ratio to be expected on theoretical grounds provided that the number of trials is very great indeed. AUTHOR.

***4791. Equation Solver. D. L. Herr and R. S. Graham.** *Rev. Sci. Instruments*, 9. *pp.* 310–314, *Oct.*, 1938.—Describes the mechanical details of the construction of a machine which will give all the roots of an algebraic equation of the eighth degree or less having real coefficients. A simple extension to the machine will permit the solution of equations with complex coefficients of any degree. The paper gives the mathematical theory on which the design of the machine is based and the equations to the various cams for controlling the potentiometers. H. H. H.

See also Abstracts 4776, 4784, 4786, 4795, 4796, 4804, 4843, 4861 and
3386B. Application of Fourier Integral. P. David.

MECHANICS, CLASSICAL.

4792. Relations between Energy Theorems Applicable in Structural Theory. D. Williams. *Phil. Mag.* 26. *pp.* 617–635, *Nov.*, 1938.—The purpose of this article is to set out the relationships linking the various energy theorems applicable to structural problems, and to comment on their respective uses and limitations. Certain relevant proofs that may be of interest are added in an appendix. AUTHOR.

4793. General Problem of Exterior Ballistics. G. Garcia. *Comptes Rendus*, 207. *pp.* 524–526, *Sept.* 26, 1938.—The problem is treated vectorially. A solution of the equation of motion is obtained by successive approximation. S. W.

4794. Impact of Falling Mass on an Elastic Rectilinear Prism. L. Bergeron. *Comptes Rendus*, 207. *pp.* 665–667, *Oct.* 17, 1938.—A simple graphical method of discussing the impact of a falling mass upon an elastic rectilinear prism is presented; the method indicates that results obtained by Saint-Venant and by Boussinesq require amendment and can be extended. J. S. G. T.

4795. General Equation of Statistical Mechanics. B. Hostinský. *Comptes Rendus*, 207. *pp.* 522–524, *Sept.* 26, 1938.—The instantaneous configuration of a mechanical system is given by Lagrangian coordinates and components of speed. An expression is obtained for the probability of travel in terms of the relative probability of quick change of some coordinates. The expression is simplified by successive approximations. R. S. R.

***4796. Mechanical Calculation of Surface Moments. F. Lorenz.** *Zeits. f. Instrumentenk.* 58. *pp.* 448–452, *Nov.*, 1938.—A description is given of the construction and method of operation of an instrument used to determine in a mechanical way the surface moments of any plane figure in reference to any selected axis. The method of working is based on a new theory which holds in a general way for the full series of surface moments. R. S. R.

See also Abstracts 4777, 4819.

MECHANICS, QUANTUM.

4797. Field Theory of the Atom. H. Takeno. *Hirosima Journ. Sci.* 8. *pp.* 271–288, *Aug.*, 1938. *In English.*—Solutions are deduced for various expressions previously found [see Abstract 1838 (1938)] for conditions of integrability of the fundamental equation of the Mimura-Morinaja wave geometry as applied to the field theory of the atom. N. M. B.

4798. Proper Transverse Energy of the Electron. G. Beck. *Comptes Rendus*, 207. *pp.* 528–530, *Sept.* 26, 1938.—Quantum electrodynamics leads to two terms for the proper energy of an electron in interaction with an electromagnetic field : longitudinal energy corresponding to the proper energy of the Coulomb field, and transverse energy due to interaction with the radiation field. The latter energy, a purely quantum phenomenon not hitherto interpreted physically, is shown mathematically to be explained, for a Dirac electron, as the energy of the magnetic field produced by the electron spin. Virtual transitions towards negative energy states do not correspond to a real phenomenon and must be excluded as are analogous transition in the Dirac theory of "holes." N. M. B.

4799. Theory of Electron Spin. W. Wessel. *Zeits. f. Physik*, 110. 9–10. *pp.* 625–660, 1938.—An attempt is made to construct a theory in which the spin appears as a consequence of the radiative reaction force. R. P.

4800. Concept of a Discrete Space-Structure. A. March. *Naturwiss.* 26. *pp.* 649–656, *Oct.* 7, 1938.—A general account is given of the theories proposed by Flint, March and Mimura based on the concept that points lying within a sphere of radius l_0, centred at any point P, are indistinguishable from P. This leads to a statistical interpretation of the meaning of distance and can also be applied to the description of a particle as something of the nature of an "extended" body and not as a geometrical point. It can also be proved that radiation of wave-length $\leq 2\, l_0$ cannot interact with a closed material system. It is shown how the value of l_0 might be determined from the energy-loss of cosmic rays as they penetrate matter. The significance of this discrete space-structure in nuclear physics is also discussed. The principal result is that β-decay cannot create electrons whose de Broglie wave-length, measured in coordinates relative to the centre of gravity, is less than $2\, l_0$. G. C. McV.

4801. Wave Functions for Na$^-$ and K$^-$. D. R. Hartree and W. Hartree. *Cambridge Phil. Soc., Proc.* 34. *pp.* 550–558, *Oct.*, 1938.—Solutions of Fock's equation for the self-consistent field with exchange have been carried out for the negative ions Na$^-$, K$^-$. The results indicate that these negative ions can certainly exist; and calculations of the energy values, and estimates of the errors of these values, indicate that these ions are probably stable and not liable to autoionisation. The wave functions for these negative ions are required in calculating atomic cross-sections for the capture of electrons by the neutral atoms. AUTHORS.

4802. Calculation of Coulomb Wave Functions for High Energies. L. E. Hoisington and G. Breit. *Phys. Rev.* 54. *pp.* 627–628, *Oct.* 15, 1938.—For high energies and moderate radii Coulomb functions are conveniently calculated by evaluating certain integrals numerically. [See also Abstract 64 (1938).] AUTHORS.

See also Abstracts 4736, 4737, 4939, 4993, 4997.

PRESSURE.

***4803. Liquid Flow in Tubes and Suction Pumps. G. Heinrich.** *Akad. Wiss. Wien, Ber.* 147. 2*a*. 1–2. *pp.* 1–28, 1938.—In a previous paper [see Abstract 5415 (1936)] the author has obtained experimentally curves showing the pressure distribution along the diffusor of a water-jet suction pump for different degrees of vacuum in the attached vessel. There is a sharp fall in pressure at a point which, as the degree of evacuation is increased, moves inwards along the diffusor. The position of this point is independent of the size of the bore of the diffusor and it is supposed that the water enters the tube as a free stream but suddenly enlarges its cross-section at this particular point and then runs on as a stream touching the walls of the tube. This kind of flow is investigated mathematically and formulae for the position along the tube where the enlargement of the jet takes place are derived and discussed. The stability of flow at this point is also investigated and it is shown that for large tubes the flow is stable, for narrow tubes unstable, results which are in agreement with experiment. The author applies his results to the flow of water in the suction pipes of a turbine and they lead to a qualitative explanation of the experimental work of V. Kaplan. Finally the air suction and the sudden compression of the air as it passes the place of greatest pressure gradient are considered. Formulae and diagrams are given showing the effect the sudden compression has on the action of the water-jet pump. S. W.

See also Abstract 4998.

RELATIVITY AND ETHER.

4804. Spinor Calculus. T. Sibata. *Hirosima Journ. Sci.* 8. *pp.* 169–186, *Aug.*, 1938. *In English.*—The real vectors and tensors which can be formed out of a spinor and a set of matrices γ_i which satisfy

$\gamma_i\gamma_j + \gamma_j\gamma_i = g_{ij}$ where g_{ij} is a fundamental tensor, are discussed. Those invariant for spin-transformation are defined and the relations existing between them are investigated. G. C. McV.

4805. Equation of Motion of a Particle in Wave Geometry. T. Iwatsuki, Y. Mimura and T. Sibata. *Hirosima Journ. Sci.* 8. *pp.* 187–192, *Aug.*, 1938. *In English.*—The fundamental spinor ψ of the author's wave geometry satisfies a fundamental equation. It is now shown that a certain vector (u^k) formed out of ψ and the matrices γ_i, where $\gamma_i\gamma_j + \gamma_j\gamma_i = g_{ij}$ [g_{ij} is the metrical tensor], is the tangent vector to a geodesic of the space. [See following Abstract.] G. C. McV.

4806. Cosmology in Terms of Wave Geometry. Part I. Y. Mimura and T. Iwatsuki. *Hirosima Journ. Sci.* 8. *pp.* 193–197, *Aug.*, 1938. *In English.*—The vector u^k defined in a previous paper [see preceding Abstract] may be interpreted as the momentum density vector of a moving particle the latter, in cosmological applications of the theory, being regarded as a nebula. The equations which u^k must satisfy, however, restrict space-time to be either that of the Einstein universe or of the de Sitter universe. [See following Abstract.] G. C. McV.

4807. Cosmology in Terms of Wave Geometry. Part II. T. Sibata. *Hirosima Journ. Sci.* 8. *pp.* 199–223, *Aug.*, 1938. *In English.*—The paper contains a detailed proof of the foregoing restriction on the metric of space-time. [See preceding Abstract.] G. C. McV.

4808. Cosmology in Terms of Wave Geometry. Part III. H. Takeno. *Hirosima Journ. Sci.* 8. *pp.* 223–237, *Aug.*, 1938. *In English.*—The explicit expressions for the vector u^k in terms of the coordinates is calculated for the de Sitter and the Einstein case respectively. [See preceding Abstract.] G. C. McV.

4809. Cosmology in Terms of Wave Geometry. Part IV. K. Itimaru. *Hirosima Journ. Sci.* 8. *pp.* 239–248, *Aug.*, 1938. *In English.*—The values of u^k [see preceding Abstract] in terms of the coordinates show that a motion of recession is possible only in the de Sitter case. It follows, however, that the total mass of matter in this universe (as defined on the basis of the vector u^k) increases with the time, although the mass of each individual particle of matter remains constant. G. C. McV.

4810. Finslerian Wave Geometry and Milne's World Structure. T. Hosokawa. *Hirosima Journ. Sci.* 8. *pp.* 249–270, *Aug.*, 1938. *In English.*—A number of theorems are worked out in Finsler geometry including the condition that two Finslerian manifolds should have the same geodesics as well as the analogues of the equations of Killing giving the group of motions of the manifold into istelf. The fundamental quadratic form for a Finsler space admitting the Lorentz group is deduced. A " wave geometry " is then constructed for Finsler space based on the idea of the " linearisation " of the expression for the interval between two neighbouring points. G. C. McV.

See also Abstracts 4797, 4800.

SOLUTION.

4811. Absorption of H_2 and N_2 by Pure Fe. K. Iwasè and M. Fukusima. *Tôhoku Univ., Sci. Reports*, 27. *pp.* 162–188, *Sept.*, 1938. *In English.*—The amounts of H_2 and N_2 observed in pure Fe at various high temperatures are volumetrically determined. Electrolytic Fe and reduced Fe, thoroughly reduced by treating them several times with dry H_2 at 1250° were used. The results obtained are in good agreement with those found in literature. AUTHORS.

4812. Solubility of H_2, D_2, and N_2 in Fe. A. Sieverts, G. Zapf and H. Moritz. *Zeits. f. phys. Chem.* 183. *Abt.A.*1. *pp.* 19–37, 1938.—Previous work is critically reviewed and compared with the authors' experimental data. For solubility of H_2 in cm.^{3} per 100 gm. Fe, the following values are reported, the mean of established values being given in brackets: At 500° C. 0·6 (0·7), at 700° C. 1·8 (1·7), at 900° C. (*A*3) 3·0 for α (2·9), 4·7 for γ (4·5), at 1100° C. 7·0 (6·6), at 1200° C. 8·2 (7·7), at 1250° C. 8·2 (7·7), at 1350° C. 10·1 (10·5), at 1400° C. (*A*4) 10·5 for γ, 10·1 for α, at 1450° C. 11·0 (12·0), at 1520° C. (m.pt.) 14 for α (13), 25 for liquid (26), at 1550° C. 26 (28), at 1650° C. (31). Values were determined with ingot iron, carbonyl iron and electrolytic iron. By difference measurements, the solubility of D_2 is deduced and found to be consistently lower than that of H_2, about 10% between 500° and 1200° C. Their behaviour is generally similar with Fe, in contrast to that with Pd. For solubility of N_2 in Fe the following figures were obtained at 754 mm:—at 1200° C. 19·2, at 1300° C. 18·2, at 1400° C. 13·9, at 1450° C. 9·3, at 1390° C. 17·2. Qualitatively the solubility diagrams show much similarity with H_2 and N_2,—increase of solubility on the $\alpha \rightarrow \gamma$ (and $\delta \rightarrow \gamma$) changes, and on melting, but with H_2 the solubility rises with temperature, while with N_2 it falls. The latter phenomenon is rare with metal-gas solutions without compound formation, *e.g.*, in Pd-H_2, Mn-H_2. D. R. H.

4813. Solubility of Slightly Soluble Silver Salts. C. Bedel. *Comptes Rendus*, 207. *pp.* 633–634, *Oct.* 10, 1938.—The solubility of AgBr in presence of the soluble compound produced when it is precipitated is scarcely affected when that product is KNO_3, $LiNO_3$, $Ba(NO_3)_2$, $Mn(NO_3)_2$, HNO_3 or H_2SO_4; but it is greatly increased if this be $Hg(NO_3)_2$, or (to a less extent) $HgSO_4$, indicating formation of some combination between AgBr and the Hg salt. The solubility of AgI varies little under similar circumstances, being approximately $4 \cdot 60 \times 10^{-5}$ gm./l. The increases in solubility with temperature of AgCl, AgBr and AgI are also given. C. A. S.

4814. Distribution of Minute Amounts of Material between Liquid Phases. D. C. Grahame and G. T. Seaborg. *Am. Chem. Soc., J.* 60. *pp.* 2524–2528, *Oct.*, 1938.—The distribution of minute quantities (*ca.* $10^{-12} - 10^{-15}$ gm.) of soluble substances between liquid phases is shown in the cases studied to be quantitatively the same as that observed for the same substances in ordinary small concentrations. Distribution ratios of several metallic halides between ether and hydrochloric acid are determined at low concentrations by the use of radioactive substances. It is shown that the technique here employed may be of use in separating and identifying artificially prepared radioactive substances without the use of a non-radioactive carrier. AUTHORS.

See also Abstract 5004.

SURFACE PROPERTIES.

4815. Theory of Adsorption when Each Particle Occupies more than One Site. J. K. Roberts. *Cambridge Phil. Soc., Proc.* 34. *pp.* 577–586, *Oct.*, 1938.—In order to be able to identify the type to which an adsorbed film belongs from its experimentally determined behaviour, it is necessary to know theoretically how various simple and general types, which are likely to occur frequently, behave. Films formed on a rectangular solid lattice with another atom at the centre of each rectangle are considered. Each adsorbed molecule is assumed sufficiently large to exclude the possibility of adsorption on the four neighbouring sites and, owing to the rectangular shape of the lattice, reacts appreciably with two and not with four neighbouring adsorbed molecules. The statistics and kinetics of the film are considered. It is shown that the variation of heat of adsorption with fraction of sites occupied is quite different from that of other types of film which have so far been treated. Immobile films of the same type are briefly discussed. [See also Abstract 3546 (1938).] AUTHOR.

4816. Electrical Factors in the Adsorption of Polar Molecules at the Surface of Solutions. R. DuBois and E. E. Todd. *Am. Chem. Soc., J.* 60. *pp.* 2355–2359, *Oct.*, 1938.—Attention is called to the fact that the adsorption of solutes at the air-solution interface, when measured by dynamic methods (moving bubbles, etc.), is generally found to be several times greater than the values calculated from surface tension data by means of the Gibbs adsorption equations. In order to test the suggestion that the excessive observed adsorption is due to electrification of the moving surfaces, the authors have attempted to alter the adsorption of *p*-toluidine on moving bubbles by forced charging of the gas. Marked decrease in the apparent adsorption was observed when the gas was subjected to spark discharge and to silent discharge before entering the adsorption apparatus. Because of its persistence after discharge ceased the effect was believed to be of chemical origin. Ionisation of the bubbling gas by exposure to ionium salt was found to have no effect on the measured adsorption. The effect of a surface charge on the adsorption of polar molecules is discussed theoretically. Calculations show that the adsorption of *p*-toluidine on gas bubbles should be only slightly increased by electrification of the surface and at extreme charge densities should be somewhat decreased. It is concluded that electrification of gas bubbles in contact with solutions of organic solutes is not responsible for the marked discrepancy between the observed adsorption and the calculated " Gibbs " adsorption. AUTHORS.

4817. Effects of Dipole Interactions on Heats of Adsorption. J. K. Roberts. *Faraday Soc., Trans.* 34. *pp.* 1342–1346, *Nov.*, 1938.—The variation in heat of adsorption with fraction of surface covered is considered for the adsorption of vapours with a permanent dipole moment on conductors. Detailed calculations show that for typical molecules the effect of the dipole interaction and of the van der Waals attraction between adsorbed molecules are of the same order and, since they are opposite in sign, the net variation in heat of adsorption is small. In carrying out the calculations the mutual repulsions and depolarising effects of the dipoles and their electric images are taken into account. [See following Abstract.] AUTHOR.

4818. Induced Dipoles and Heat of Adsorption of Argon on Ionic Crystals. J. K. Roberts and W. J. C. Orr. *Faraday Soc., Trans.* 34. *pp.* 1346–1349, *Nov.*, 1938.—The electrostatic field at points equidistant from four ions near the surface of a 100 plane in a body-centred alkali-halide crystal is calculated. It is shown that, as in the case of permanent dipoles on conductors discussed in the previous paper [see preceding Abstract], the effect of the dipoles induced by this field in argon adsorbed on CsI makes the variation in heat of adsorption with fraction of surface covered considerably less than it would be if only van der Waals' forces were present. AUTHORS.

4819. Relative Adsorbabilities of H_2 and D_2. A. Wheeler. *J. Chem. Phys.* 6. *p.* 746, *Nov.*, 1938.—The unexpected results of Beebe, Klar and others on the relative adsorbabilities of H_2 and D_2 on metal surfaces are explained by a statistical-mechanical treatment. By constructing simple partitition functions for the adsorbed molecules and atoms, equal adsorption at low temperatures and an inversion temperature at higher temperatures are predicted. Both predictions are fulfilled by the experimental results. AUTHOR.

***4820. Measurement of Surface Tension and Density. E. Tyler.** *Am. Phys. Teacher*, 5. *pp.* 195–197, *Oct.*, 1937. *School Science Rev.* 20. *pp.* 41–48, *Oct.*, 1938.—Measurement of the apparent loss in weight (m) of either a partially immersed glass plate or hollow tube at varying depths (h) in water is made with the aid of a torsion balance. The linear relationship existing between (m) and (h) is confirmed by graphical representation. From a knowledge of the intercepts and the gradient of the resulting graph the coefficients of surface tension and density of the liquid are derived. The method is only applicable to liquids having zero angles of contact. AUTHOR.

4821. Surface Tension and Internal Heat of Vaporisation. O. Albert and F. Eirich. *Zeits. f. phys. Chem.* 183. *Abt. A.* 1. *pp.* 9–18, 1938.—The relation between the molecular surface energy μ_σ and the heat of vaporisation l_i of nonylene-, nonyl-, and oleic acid esters was deduced with the aid of the data recently published by Albert. Extrapolation on the basis of molecular weights was necessary, but this was justified by the fact that the Stefan factors thus found are independent of temperature, and the heats of vaporisation are additive. The values of l_i are as expected, and the values of μ_σ and l_i/μ_σ are explained on the basis of the Langmuir conception of molecular orientation in the surface layer. P. H. B.

4822. Lowering of Surface Tension of Water by Electrolytes. J. J. Bikerman. *Faraday Soc., Trans.* 34. *pp.* 1268–1274, *Nov.*, 1938.—A theory of the surface tension of electrolytic solutions is given. The work associated with an extension of the surface of solution consists of three parts, namely, (1) the work of bringing water molecules on to the surface; this term is independent of the concentration, (2) the work of compressing the ions into a smaller volume ; this " Wagner " term rises with the concentration, and (3) the work of separating positive and negative charges under the surface ; this term rapidly decreases with concentration. The combined effect of these terms produces a surface tension-concentration curve which agrees with experimental data of Jones and Ray. [See Abstract 1074 (1937).] AUTHOR.

4823. Low-Temperature Oxidation of Iron. H. R. Nelson. *J. Chem. Phys.* 6. *pp.* 606–611, *Oct.*, 1938.—An electron diffraction study of oxide films formed on Fe heated in air at 80-260°C. failed to detect any " critical temperature " near 200°C. Oxidation below 130°C. strengthened the pattern of the primary oxide film of γ-Fe_2O_3 or Fe_3O_4, whilst above this temperature α-Fe_2O_3 was obtained provided a critical period of oxidation was exceeded. It is shown that the primary oxide film cannot be thicker than 200 Å. The appearance of the first-order blue interference colour at 193°C. coincided with the formation of a new type of α-Fe_2O_3 film which was attributed to the outward diffusion of iron through the oxide layer. A. G. Q.

4824. Flow and Viscosity of Monomolecular Films. M. Joly. *J. de Physique et le Radium*, 9. *pp.* 345–351, *Sept.*, 1938.—The various theories dealing with this subject are described and the limits of their applicability discussed. The two-dimensional viscosity of a monomolecular film, and hence the viscosity per molecule, are calculated, the former being shown to be incomparably greater than the ordinary three-dimensional viscosity. [See Abstracts 496 and 996 (1938).] C. A. S.

4825. Surface Viscosity of Long-Chain Alcohol Monolayers. L. Fourt and W. D. Harkins. *J. Phys. Chem.* 42. *pp.* 897–910, *Oct.*, 1938.—Methods based on the damping of oscillating rings, discs, and vanes by a surface film give values of the surface viscosity which agree well enough to indicate the usefulness of such methods. A continuous rotation device, although not yet refined to the same degree of usefulness, gives similar values. Theory indicates that such a device would possess advantages for use with plastic films, and that it could be adapted to give absolute values of surface and interfacial film viscosities, free from subphase effects. The viscosity of expanded films of the normal alcohols is too low to measure by these means. Measurements were obtained on condensed films of the five alcohols from C_{14} to C_{18} inclusive. The low pressure linear part of the compression curve corresponds to low values of the surface viscosity, increasing more and more rapidly with increasing pressure. For this portion the longer the chain, the higher the viscosity. The high pressure linear part of the compression curve corresponds to high apparent viscosities, which are greater for lower rates of shear. These values, compared at a single average rate of shear, rise to a maximum as the pressure increases, then fall off with the approach of film collapse. Of the alcohols examined, only octa-decyl alcohol shows non-Newtonian viscosity below the kink point. The singular point or, as recent findings show, region of the force-area curves corresponds to the transition in viscosity. AUTHORS.

4826. Increase in Viscosity of Mineral Oil at Rest. A. Marcelin. *Comptes Rendus*, 207. *pp.* 616–618, *Oct.* 10, 1938.—The viscosity of a film of mineral oil was measured by the distance (*d*) traversed by a ball with fixed initial velocity along a horizontal groove covered with a film of such oil about 1 mm. thick ; *d* is approximately 25% greater, and the viscosity by so much less, when the oil has been recently placed on the groove, than it is when it has been standing several hours. In this latter case several repeated passages of the ball reduces the viscosity to its initial value. This is attributed to the molecules of oil being polarised on standing, but caused by repeated passages of the ball to take up positions inclined to the direction of, and so facilitating, the movement of the ball, whence they take time to recover. C. A. S.

4827. Carrier Mobility Spectra of Liquids Electrified by Bubbling and Spraying. S. Chapman. *Phys. Rev.* 54. *pp.* 520–533, *Oct.* 1, 1938.—The mobility spectra produced by bubbling water and various aqueous solutions of salt, acid, base, sugar, and soap were investigated with an Erikson mobility tube under high resolving power. Current-mobility curves show that for water there are two positive groups and five negative groups of carriers having mobilities of 1·8 to 0·2 cm/sec. per V/cm. The ratio of the total amount of positive electrification to negative increases as the size of the bubbling capillary increases. Addition of salts to water favours production of slow carriers at the expense of fast ones. Medium concentrations (10^{-3} molal) produce more total electrification than distilled water, and high concentrations (1 molal) less. With the addition of sugar to water several groups of large numbers of carriers of various mobilities appear, and the total amount of electrification increases to about 12 times that for water. Air blasts of high humidity favour production of slow carriers and give heterogeneous spreads of mobilities. The group of negative carriers of mobility 1·8 produced by bubbling distilled water may be interpreted as consisting of a normal negative ion in moist air; the positive and negative groups at $+1\cdot0$ and $-0\cdot95$ appear to be due to carriers containing an extra H^+ and OH^- ion, respectively. It is likely that the other distilled water groups are formed partly by the uniform breaking of the thin bubble film and partly by the evaporation of larger carriers. N. M. B.

See also Abstracts 4747, 4774, 5036, 5042, 5047, 5048.

TIME.

✱4828. New Schuler Clock. A. Scheibe. *Zeits. f. Physik,* 110. 9–10. *p.* 660, 1938.—In the paper by H. Gockel and M. Schuler [see Abstract 3560 (1938)] the authors claimed that their pendulums had a logarithmic decrement lower than that of the best piezoelectric quartz resonators. It is now pointed out that, in fact, considerably lower values have been obtained by the vibrating quartz method. R. P.

VISCOSITY AND FRICTION.

4829. Rates of Displacement in Viscous Bodies under Applied Stress. R. W. Douglas. *Soc. Glass Technol., J.* 22. *p.* 259, *Aug.*, 1938.—A correction to the original [see Abstract 3563 (1938)]. AUTHOR.

4830. Viscosity of Dilute Solutions of Long-Chain Molecules. Part I. M. L. Huggins. *J. Phys. Chem.* 42. *pp.* 911–919, *Oct.*, 1938.—By an extension of Kuhn's hydrodynamical treatment a theoretical equation has been derived relating the specific viscosity of a solution to the coordinates and dimensions of the atoms in the solute molecules. Applied to rod-like molecules this equation leads to proportionality (with n large) between η_{sp}/c and n^2. Applied to randomly kinked chain molecules, it leads to proportionality between η_{sp}/c and n, the Staudinger relationship. Theoretical expressions have been obtained for the proportionality constant and also for the deviations for small values of n. Using a reasonable value for the "effective radius" of the CH_2 group, without any arbitrary constants whatever, the experimental data for solutions of paraffins are quantitatively accounted for. AUTHOR.

4831. Viscosity of Aniline. L. A. Steiner. *Indust. & Engin. Chem.* (*Analytical Edition*), 10. *pp.* 582–584, *Oct.* 15, 1938.—The viscosity of "chemically pure aniline," $d^{20}_4 = 1\cdot0208 \pm 0\cdot0003$, was determined at 5° intervals from 20° to 100° C. within an error of $\pm 0\cdot20$ to $\pm 0\cdot30$ %. The measured viscosities were compared with the results in the literature, the latter being in part confirmed and in part found doubtful. The author's results, comprising the most accurate and complete data available for the viscosity of aniline, make possible calibration at 100° C. with the same accuracy as has been accepted with water at 20° C. In comparison with water, aniline as a calibration liquid has the advantages of higher viscosity, much lower surface tension, and applicability at high temperatures. AUTHOR.

4832. Viscosity of Starch Pastes. J. R. Katz, M. C. Desai and J. Seiberlich. *Faraday Soc., Trans.* 34. *pp.* 1258–1268, *Nov.*, 1938.—It was found that a starch paste is not at all comparable with a colloidal solution or a colloidal gel. When heated or mechanically treated, the thin vesicle walls break. They break much more readily under mechanical treatment on heating than at room-temperature or at 0° C. Instead of being plastic, the vesicle walls at lower temperature have become elastic. This same fact is responsible for the setting of starch puddings. Even in 1% starch pastes there is no proportionality between viscosity and concentration. The microscopical picture is too complicated for such a simple proportionality. In the same way, there is no reason to expect that (even for 1% pastes) the viscosity is independent of the pressure under which it flows. The factor which probably contributes most to the complexity of the system is the relatively small amount of free water between the vesicles. In concentrated starch pastes this water almost vanishes (or shrinks to a small amount). The viscosity (especially at the maximum, but probably all along the viscosity curves) is due, not only to a flow of water, made somewhat more difficult by the suspension in the water of a large amount of starch vesicles, but also to the rubbing of these vesicles against one another. This has to be taken into account as an essential part of the viscosity. AUTHORS.

See also Abstracts 4825, 4994.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4833. Half-Filter Method of Photographic Photometry of Stars. O. Heckmann and H. Kienle.** *Göttingen Nachrichten, Fachgruppe II.* 2. 17. *pp.* 203–215, 1937.—Describes a modified form of the Kapteyn-Schwarzschild half-screen method of stellar photometry [see Abstract 505 (1933)] in which the wire screen is replaced by a neutral filter made by kathodic sputtering of Pt. The theory of the method is described in detail. J. W. T. W.

COMETS AND METEORS.

4834. Motion of Periodic Comet Kopff (1906e). F. Kępiński. *Acad. Polonaise Sci. et Lettres, Bull.* 3-5*A*. *pp.* 179–202, *March–May*, 1938. *In English.*

COSMOGONY.

See Abstracts 4805, 4806, 4807, 4808, 4809, 4810.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

4835. Motion of Apsidal Line in Close Binary Systems. T. G. Cowling. *Roy. Astron. Soc., M.N.* 98. *pp.* 734–744, *Oct.*, 1938. *Supplement.* It is pointed out that the discussions of the motion of the apse-line in binary stars given by Russell, Walter and Kopal [see Abstract 2754 (1938)] all depend to a smaller or greater extent on an assumption that the stars can be regarded as rigid during the motion. When regard is paid to the fact that the stars are not rigid, a formula for the rate of advance of periastron is obtained, similar to Russell's, but differing in the numerical factor attached to certain of the terms. The density-concentrations of the stars which are deduced frrom the new formula are far more closely in agreement with Eddington's theory than those found by Russell. It is also noted that the librations of non-rigid stars are far more rapid than those of rigid stars: in consequence, the results regarding the density distribution derived by Walter from the periods of libration are not valid. AUTHOR.

See also Abstract 4880.

NEBULÆ.

4836. Physical Processes in Gaseous Nebulæ. Part V. Electron Temperatures. J. G. Baker, D. H. Menzel and L. H. Aller. *Astrophys. J.* 88. *pp.* 422–428, *Nov.*, 1938.—The relation between the electron temperature of a gaseous nebula and the temperature of the exciting star is derived and applied to an optically thin nebula. The b_n's have been recomputed both with the radiation field included and as a function of the temperature of the exciting star. The Balmer decrement proves to be steeper when the influence of Lyman line absorption is included. [For Part IV see Abstract 4385 (1938).] AUTHORS.

PLANETS.

4837. Two New Satellites of Jupiter (J X and J XI). J. Jackson. *Roy. Astron. Soc., Occasional Notes, No.* 2. *pp.* 23–25, *Oct.*, 1938.—For J XI no orbit is found; for J X, it is uncertain whether the orbit is direct or retrograde; if direct, $a = 5{\cdot}9 \times 10^6$ miles, $e = 0{\cdot}636$; if retrograde $a = 18{\cdot}3 \times 10^6$ miles and $e = 0{\cdot}621$. If J X is direct, it will interlock with J VI and J VII; if retrograde, it will class with J VIII and J IX. On both assumptions the eccentricity is larger than anything, except comets, in the solar system. Both satellites are probably less than 10 miles in dia. and the large range in size for Jovian satellites should prove of cosmological importance; it may be that J X is not a permanent satellite, owing to the great solar attraction upon it; it may be sometimes a satellite and somes a minor planet. A. S. D. M.

STARS.

4838. Photographic Red-Intensities of Praesepe. O. Heckmann. *Göttingen Nachrichten, Fachgruppe* II. 2. 18. *pp.* 217–236, 1937.—A method is described by which the magnitudes of the stars of the Praesepe cluster were determined in red light. The Schott-filter RG1 together with Agfa-plates (*Spektral Rot Hart*) gave the centre of gravity of the spectral region at 6450 ± 15 Å. The corrections are given which must be applied to the measurements, and the accuracy of the method is discussed in detail. The results of the observations are compared with those of other observers. [See following Abstract.] L. K.

4839. Colour-Luminosity Diagram of Praesepe. H. Haffner and O. Heckmann. *Göttingen Nachrichten, Fachgruppe II.* 2. 19. *pp.* 237–255, 1937.—The colour indices and stellar magnitudes m_{4270} and m_{6450} which have been determined photometrically, are tabulated for the stars of the Praesepe cluster together with those of some brighter red stars and weaker white stars which do not belong to the cluster. The relation between the colour indices and the luminosities is shown in a diagram. Along the line round which the greater part of the stars is distributed, the relation between colour and luminosity is unambiguous. Among the stars of $m > 8\cdot5$ are approximately 20% double stars which lie outside this line. Their number does not depend on the absolute magnitude and corresponds to the usual ratio of spectroscopic double stars of the type A, F and G occurring among giant stars. [See preceding Abstract.] L. K.

4840. Scatter of Absolute Magnitudes in the Main Sequence. J. Hopmann. *Naturwiss.* 26. *p.* 631, *Sept.* 23, 1938.—By using the most recent and accurate catalogues of apparent magnitudes, spectral types, and parallaxes, the scatter in the absolute magnitude-spectral type diagram is found to be ± 0·54 mag. between A0 and K6 stars. To the experimental uncertainty the photometric results contribute least and the parallax measures, even for selected stars at small distances, most. Allowing for these sources of error, the cosmical scatter in the neighbourhood of the sun reaches ± 0·40 mag., much more than that observed in the Praesepe cluster. The figure for the Pleiades is ± 0·25, for the Hyades ± 0·35, both also much greater than for the Praesepe cluster. In the Hyades, as in the neighbourhood of the sun, a third of the stars are visual or spectroscopic binaries. The preponderance of F, G, and K stars in these regions suggests that duplicity in stellar systems is still more likely to be a normal development than had hitherto been supposed. A. Hu.

4841. Generalisation of Lindblad's Theory of Star-Streaming. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 98. *pp.* 710–726, *Oct.*, 1938. *Supplement.*—The treatment of the observed stellar motions shows that the axis of preferential motion—the largest axis of the velocity ellipsoid—lies in the galactic plane and is directed towards the galactic centre (this is the radial axis). On the other hand, the theoretical study of stellar systems, with cylindrical symmetry and assumed to be in a steady state, has hitherto led to the result that the radial axis and the axis perpendciular to the galactic plane (the polar axis) are equal. By a generalisation of Lindblad's theory of star-streaming [see Abstract 3089 (1936)] the paper removes this inconsistency and demonstrates that, for a steady state of the system, the radial and polar axes are unequal. The paper also predicts for a group of stars at a considerable height above the galactic plane a definite tilt of the principal axes of the velocity ellipsoid in the meridian plane; in other words, the greatest axis is no longer parallel to the galactic plane. AUTHOR.

4842. Radial Velocity-Curve of the RR Lyræ Variable W Canum Venaticorum. A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 599. *Astrophys. J.* 88. *pp.* 408–410, *Nov.*, 1938.—24 spectrograms of the short-period variable W Canum Venaticorum were obtained, mostly by the use of a 6-in. camera and a one-prism spectrograph giving a dispersion of 120 Å/mm. The velocity-curve closely resembles the light-curve by Detre, but a lag of 6% of the period is noted. The normal velocity is + 26·0 km./sec. with a total range of 70 km./sec. The spectroscopic absolute magnitude of — 0·4 and a distance of 1400 parsecs were determined. AUTHOR.

4843. Tables Facilitating Calculation of Line Absorption Coefficients. F. Hjerting. *Astrophys. J.* 88. *pp.* 508–515, *Nov.*, 1938.—A table of the integral $\frac{a}{\pi}\int_{-\infty}^{+\infty}\frac{e^{-y^2}dy}{a^2+(v-y)^2}$ is calculated by numerical quadratures for values of a up to 0·2, and, with somewhat less accuracy, for values of a up to 0·5. AUTHOR.

4844. Integration of Equation of Radiative Transfer. P. Swings and L. Dor. *Astrophys. J.* 88. *pp.* 516–521, *Nov.,* 1938.—The equation of radiative transfer has been integrated by a generalisation of Spitzer's method, which makes use of Bessel functions. [See Abstract 524 (1938).] AUTHORS.

4845. Nuclear Transformations in the Interior of Stars. Part II. C. F. v. Weizsäcker. *Phys. Zeits.* 39. *pp.* 633–646, *Sept.* 15, 1938.—The difficulties of the author's hypothesis [for Part I see Abstract 1989 (1937)] are outlined. The synthesis of the heavier elements from neutrons, whose production is bound up with that of He, leads to a lower limit to stellar He abundance which is incompatible with observational evidence. The energy production in stars is likely to depend only on reactions involving the lighter nuclei, the determining ones as yet being uncertain. The cyclic processes of Part I are now considered unlikely from the point of view of nuclear physics, and a cycle in which C catalyses the production of He is suggested. Such a cycle gives an abundance distribution of the lighter elements in accordance with observation. Different types of reaction have to be assumed for giants and dwarfs respectively; for the former a steady cyclic process is suggested, for the latter a nuclear decomposition. The necessary physical conditions for the formation of the elements are investigated, particular attention being paid to the temperatures (*c.* 2×10^{11}) needed for the production of all nuclei in comparable numbers. Where the mass involved is of an order greater than stellar masses, such temperatures can probably be produced temporarily, but are followed by an explosion. The bearing of this idea on the redshift of the spiral nebulæ is discussed. A. Hu.

4846. Microphotoemeter Measurements of Variable Star SU Draconis in 1935-1936. W. Opalski. *Acad. Polonaise Sci. et Lettres, Bull.* 3–5*A. pp.* 204–217, *March–May,* 1938. *In German.*

4847. Photographic Light-Curves of the Two Supernovæ in IC 4182 and NGC 1003. W. Baade and F. Zwicky. *Mt. Wilson Observat. Contrib. No.* 601. *Astrophys. J.* 88. *pp.* 411–421, *Nov.,* 1938.—Photographic light-curves of the two supernovæ in IC 4182 and NGC 1003 have been derived from plates obtained at the Palomar and the Mount Wilson observatories. Since the distance moduli of the two nebulæ are known, the absolute photographic magnitudes of the supernovæ can be computed. At maximum their values were $M = -16\cdot6$ and $-14\cdot0$, respectively. An integration of the light-curve of the supernova in IC 4182 shows that during the outburst this star emitted radiation in the photographic region equivalent to $4\cdot10^7$ years of solar radiation within the same spectral range. AUTHORS.

4848. Spectral Classification in Kapteyn's Selected Areas. H. Brück. *Observatory,* 61. *pp.* 262–267, *Oct.,* 1938.—The *Spektral Durchmusterung* of the southern Kapteyn area (70,000 stars down to the 12th mag.) and the Bergedorfer *Spektral Durchmusterung* for the northern area, are now complete. The author reviews this work and its history, beginning with the Draper catalogue, containing 225,700 stars down to mag. 8·5. For these, the types A and K are most frequent, but going from brighter to fainter, B stars decrease in number, G stars increase; the frequency of other types being constant. Early stars concentrate towards the Galaxy, but F and G stars do not. Both the new catalogues give indications for brighter stars if they are giants or dwarfs. Both show that even in the Milky Way there are no B stars of the 12th mag.

The *Spektral Durchmusterung* derives density gradients for different galactic latitudes but here are seen the limitations of the Kapteyn areas, since these are distributed symmetrically to the equator, and include only a small part of the Milky Way. A. S. D. M.

See also Abstracts 4833, 4835.

SUN.

4849. Corpuscular Eclipse of 1940 Oct. 1. *Roy. Astron. Soc., M.N.* 98. *pp.* 727–733, *Oct.*, 1938. *Supplement.*—A brief description is given of the adaptation of the occultation machine in the *Nautical Almanac* Office to the prediction of the corpuscular eclipse ; times of beginning and end at a network of points covering South Africa are tabulated for the two heights of 100 km. and 300 km. and for two assumptions as to the effective radiating diameter of the sun. A speed of propagation of 1000 miles a second is assumed for the particles, but an indication is given of the variation of the times for a change in the assumed speed. [See also Abstract 4011 (1938).]

4850. Hydrogen Lines Near the Balmer Limit. A. Pannekoek. *Roy. Astron. Soc., M.N.* 98. *pp.* 694–709, *Oct.*, 1938. *Supplement.*—The theoretical work of Robertson and Dewey [see Abstract 2721 (1928)], and of Lanczos [see Abstract 2313 (1931)] on the dissolution of the highest levels of an atom by electric fields is applied to the disappearance of the higher members of the Balmer series. Their intensity curves in the emission spectrum of a partly ionised gas are computed. The merging of the highest Balmer lines into continuous radiation allows the derivation of the electron density in an atmosphere by means of the number of visible lines. This is applied to the solar chromosphere. AUTHOR.

V. 19

GEOPHYSICS.

GEOPHYSICS, APPLIED.

***4851. Short-Period Fractional Error of a Coincidence Theodolite. H. Kasper.** *Zeits. f. Instrumentenk.* 58. *pp.* 443–448, *Nov.*, 1938.—A series of tests was carried out on some modern theodolites with coincidence readings to determine whether the newly finished circular divisions on glass also had the short-period fractional errors such as can be observed on metal circles of the time of Forster. The programme of tests and the derivation of the errors are described. The results show that for a Zeiss universal theodolite, II, the errors are not present. R. S. R.

See also Abstract 4874.

HYDROSPHERE, PHYSICS OF THE.

4852. Radium Content of Marine Sediments. Robley D. Evans and A. F. Kip. *Am. J. Sci.* 36. *pp.* 321–336, *Nov.*, 1938.—The mean Ra concentration in 11 terrigenous-mud ocean-bottom deposits from the vicinity of the East Indies, the Philippines and Japan is $2{\cdot}5 \times 10^{-12}$ gm. Ra per gm., or about 5 to 10 times the usual values for sedimentary rocks. The terrestrial occurrences of so-called fossil deep-sea clays on Borneo, Rotti and Timor have a much lower Ra concentration than contemporary deep-sea red-clays or even terrigenous muds. These analyses suggest either that Ra, not U, is primarily precipitated in the ocean-bottom sediments, or that the East Indian fossil deep-sea clays are shallow-water deposits. The geological evidence supporting the abyssal origin of these deposits seems strong enough to warrant the conclusion that the high Ra content of fresh deep-sea red clays is mainly due to the precipitation of Ra itself, without regard to the oceanographic behaviour of U. AUTHORS.

LAND, PHYSICS OF THE.

4853. Magnetic Anomalies and Subterranean Mass Distribution. T. Nagata. *Tokyo Univ. Earthquake Research Inst. Bull.*, 16. *pp.* 550–576, *Sept.*, 1938. *In English.*—An extension of a previous paper [see Abstract 4022 (1938)]. Relations are established between the magnetic anomalies and the corresponding subterranean magnetic plane and magnetic dykes, and examples of each are given. Finally the magnetic anomalies in dip and declination are treated. Correction formulae must be used for the observed values where the earth's surface is too undulating to be treated as a horizontal plane. R. S. R.

4854. Effect of Cooling on a Plastic Earth under Gravitational Forces. Part II. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 527–536, *Sept.*, 1938. *In English.*—Continuing previous work [see Abstract 4028 (1938)] in which the cooling of a uniform layer was assumed to take place uniformly, the case is investigated in which cooling in the earth's crust is of any distribution with depth. The effect of the cooling of any part of the earth on its plastic deformation is slight compared with the effect of gravitational forces on the same deformation. An important condition is that the rigidity of the crust shall not be zero, for the state of a solid earth differs from that of a liquid earth of equal radius. The plastic stress due to temperature change never participates greatly in the total stress. W. A. R.

METEOROLOGY.

4855. Vertical Distribution of Atmospheric Ozone. F. W. P. Götz. *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 253–325, 1938. —Review of the subject, containing a Bibliography of 318 references.

4856. Frontal Movements Contrary to Indicated Gradient Flow. A. K. Showalter. *Monthly Weather Rev.* 66. *pp.* 165–174, *June*, 1938.—A problem which often presents itself is the movement of a front against the gradient flow indicated by sea-level isobars. The displacement of a frontal surface is produced by component winds normal to the front. There is also the effect of the isallobaric component. This may be in the opposite direction to the gradient flow especially near a warm front. It is, therefore, possible that a front may move against the indicated gradient. This can be applied to the solution of the problem of a cold front extending to the north or north-east of a low pressure. A detailed treatment is given of the flood-producing storm in Oklahoma in April, 1934, where such a front was present and moved against the gradient flow. The author considers that the displacement in this and similar cases took place by means of the isallobaric component. Further, as the result of the opposing forces is to sharpen the temperature contrast along the trough, there is instability and a continuous breaking down by minor waves. The minor waves may become intense and produce heavy rains. Many synotpic charts illustrate the paper. A. E. M. G.

4857. Tornado of July 7, 1938, in Chiltern Hills. E. L. Hawke. *Roy. Meteorolog. Soc., J.* 64. *pp.* 616–618, *Oct.*, 1938.—The phenomenon which is described in detail occurred during one of the many thunderstorms which broke over England on that date. It appears to have been coincident with the passage of a well marked cold front. An account of the damage done is given and a diagram shows the track of the storm. A. E. M. G.

4858. Artificial Snow. U. Nakaya. *Roy. Meteorolog. Soc., J.* 64. *pp.* 619–624, *Oct.*, 1938.—The author, having first made clear what he means by the term " snow crystal ", proceeds to describe the methods used for producing these crystals. The apparatus used is shown diagrammatically. It was placed in a chamber which could be cooled to −50° C. The crystals were formed on a fine hair or fibre and records of the temperature of the evaporating surface, the fibre and the chamber were made. Twelve types are illustrated, which are classified in three groups. Investigation shows that the form of the crystals in the early stage exerts a strong influence on the mode of growth of the snow crystal proper. The temperature conditions under which different types are formed are stated, from which conditions in nature may be inferred. Investigations are also being pursued to determine the conditions under which ice of different crystal symmetry is formed. From experiments on sublimation of ice the author considers that delicate ice crystals are formed in an unstable state by the *mixing* of saturated air at a low temperature with warm vapour. To test this, further experiments are proceeding. A. E. M. G.

4859. Industrial Smoke Drift and Weather. H. H. Lamb. *Roy. Meteorolog. Soc., J.* 64. *pp.* 639–643, *Oct.*, 1938.—Particulars are given of a series of observations made in East Scotland when passing through an area of smoke haze drifting from Glasgow. The effect of the hills in deflecting the smoke drift was pronounced. At one point the smoke was accompanied by slight rain and it is concluded that this forms an example of the instability of a cloud of drops, called by Shaw the " effect of capillarity," whereby the bigger drops grow by slowly stealing water from the smaller ones. R. S. R.

4860. Atmospheric Condensation Nuclei. H. Landsberg. *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 155–252, 1938. *In English.* —Review of the subject, containing a Bibliography of 227 references.

4861. Apparent Persistence of One Type of Weather. W. G. Cochran. *Roy. Meteorolog. Soc., J.* 64. *pp.* 631–634, *Oct.*, 1938.—If a meteorological event is of two types only, for instance wet or dry months, and these occur independently with equal probability, Gold showed that the probable number of runs of length, r, out of m events is $(m+3-r)/2^{r+1}$. Two further results are needed to complete the application of the formula. (1) The formula is extended to cases in which the chances of two events are unequal and it is shown that the comparison of the observed set of runs with Gold's formula suggests the persistence of long runs whether there is any real persistence or not. (2) An objective test of significance is required giving the exact probability that a given set of runs, or a more divergent one, should have occurred without any real tendency to recurrence. This is illustrated by two examples. R. S. R.

4862. Coronæ and Anticoronæ in Fogs. J. Bricard. *Comptes Rendus*, 207. *pp.* 538–540, *Sept.* 26, 1938.—When the mean radius of particles is less than 8μ, then the presence of diffraction rings in coronæ can be detected. To obtain coronæ the author used a Hg arc with suitable filters as a source of monochromatic light, allowing the light to pass through several metres of fog. From the diameters of the coronæ so obtained, the radii of the particles were calculated and the values found to agree satisfactorily with those obtained by two other methods. The method of obtaining coronæ and anticoronæ is next described. A correspondence is shown to exist between certain rings in the two sets, and from the diameters of the anticoronæ, the radii of the particles were found. An examination with a Savart plate revealed the presence of a certain amount of polarised light in the coronæ. **Errata,** *ibid. p.* 604, *Oct.* 3, *and p.* 878, *Nov.* 7, 1938. A. E. M. G.

4863. Aurora of January 25-26, 1938. C. Störmer. *Naturwiss.* 26. *pp.* 633–638, *Sept.* 30, 1938.—1685 photographic observations of auroræ have been made on 28 nights from Jan. to June, 1938, at Oslo and at 7 other stations within a radius of 130 km., arranged in 2 networks of 4 stations each. In many cases simultaneous observations at two or more of these stations enable the height and geographical position of the auroræ to be calculated. Results are given in detail for the intense display of Jan. 25–26, photographs of the various curtains and streamers being reproduced and discussed. The green rays appear at heights of the order of 100 km., the red at about 600 km. Streamers some 200 km. long extended from N. to S. over E. Denmark, whilst some extended from E. to W. over the North Sea practically from the Scottish coast to that of Norway. Spectroscopic observations establish that the difference of colour is due to a difference of relative intensity in the spectral lines and bands: all auroræ show the 6300 and 5577 Å lines and the 6550 and 4278 Å bands, but in the red glow the red O line is by far the strongest feature. A. Hu.

4864. Auroral Spectrum. L. Vegard. *Naturwiss.* 26. *pp.* 639–644, *Sept.* 30, 1938.—The author emphasises the importance of the study of auroral phenomena in increasing our knowledge of the composition and physical condition of the upper atmosphere. The electronic transitions giving the N_2 and N_2^+ bands and the O I lines in the auroral spectrum are discussed, and the production is described of certain of these features in the luminescence of solid nitrogen and in afterglow spectra. The author reviews the results obtained from a study of the intensity distribution of the lines in a band, of the bands in a system, and of the systems in the whole spectrum. Possible mechanisms are discussed for the reactions between nitrogen and oxygen molecules and atoms in the upper atmosphere. The concentration of O atoms appears to vary with solar activity. The nature of the solar agencies producing the auroræ is discussed in conjunction with the recent results on the constitution of the ionosphere obtained by radio echo sounding. A. Hu.

4865. Polar Aurora and Night-Sky Light. H. H. Plaskett. *Roy. Astron. Soc., Occasional Notes, No.* 2. *pp.* 13–22, *Oct.,* 1938.—General features of the aurora relating to its height, the two types, the lines and bands in its spectrum, and the atomic transitions causing them are described. The method of measurement, layers of origin, spectral investigations and their variation with time for the night-sky light are next discussed. For the origin of these phenomena Chapman's theory for the night-sky light, those of Birkeland, Störmer and Lindemann for the aurora, and of Milne for magnetic storms are outlined. It is concluded that further investigation is needed to decide the connection between these three phenomena. R. S. R.

4866. Brightness of Sky in Zenith. P. Gruner and T. Klee. *Helv. Phys. Acta,* 11. 6. *pp.* 513–530, 1938. *In German.*—An attempt is made to calculate the brightness of a clear sky for red, green and blue light. The theory is simplified by neglecting multiple scattering in the atmosphere, the effect of which is assumed to be small. Deviations of observed values from those now calculated are attributed to turbidity in the sky, and can be used to investigate such turbidity. C. B. A.

4867. Recent Twilight Investigations. P. Gruner. *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 113–154, 1938.—Review and Bibliography of the subject.

***4868. Psychrometric Charts. J. G. Albright.** *Monthly Weather Rev.* 66. *pp.* 178–181, *June,* 1938.—Two charts have been constructed, one for use with Fahrenheit temperatures, the other for Centigrade, from values given in the Psychrometric Tables and Relative Humidity, Centigrade Temperature publications of the U.S. Weather Bureau. The method of constructing charts is given and an example of their use set out. Great accuracy in the results attainable is not claimed. The charts are reproduced. A. E. M. G.

***4869. Exploration of Atmosphere by Radio-Sonde. R. Bourgeois.** *Comptes Rendus,* 207. *pp.* 611–613, *Oct.* 10, 1938.—At Trappes a radio-sonde ascent has been made each day since Jan. 1, 1938, and in six months 181 ascents reached the stratosphere. The cruise of the ship *Carimaré* near the Azores has provided a full forecasting station day and night in this area and ship and land observations have been collected. Radio-sonde ascents have been made each day for three months from the ship. Details are given of the height and temperature at the tropopause for the land and sea stations. R. S. R.

***4870. Pilot Balloon Theodolite. R. Cranna.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 613–615, *Oct.,* 1938.—The types of pilot balloon theodolite used are all based on that designed by de Quervain in 1905. The features of the two main types hitherto used at the Meteorological Office outstations are described. The present instrument has been built to incorporate the desirable features of the two types and to improve upon any shortcomings common to both. The remodelling of the mechanical system which is fully described has simplified the illumination of the theodolite necessary for night ascents. A. E. M. G.

***4871. Anemoclinometer I.M.F.L. G. T. Walker.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 625–629, *Oct.,* 1938.—In a description of the instrument it was stated that although the anemoclinometer was fixed in direction the registration was not affected by more than 3% provided that the angle (j) between the wind and the direction in which the instrument was pointing was not more than 45°. It was also shown how small angles such as 4° in the inclination (i) of the wind to the horizontal or the azimuth (j) could be derived from the traces. Formulæ were developed for these cases by Martinot-Lagarde and diagrams are given showing the large range over which they apply. It is confirmed that for such cases as normally occur in ordinary weather with $i \ngtr 5^\circ$ and $j < 45^\circ$ the formulæ hold and i and j can be readily determined. R. S. R.

4872. Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year Ended March 31st, 1938. *Air Ministry Publications, M.O.* 428. [61 *pp.*], 1938.

4873. Aerological Observations by Means of Kites, Aeroplanes and Sounding Balloons in U.S.A. C. M. Lennahan. *Monthly Weather Rev. Suppt. No.* 38. [65 *pp.*], *Sept.*, 1938.

See also Abstracts 4748, 4904, 4935, 5003, 5075 and
3484B. Progress in Weather Forecasting. W. R. Gregg.

SEISMOLOGY.

4874. Explanation of Different Wave Groups in Seismograms of Explosions. R. Köhler. *Göttingen Nachrichten, Fachgruppe II.* 2. 13. *pp.* 145–165, 1936.—Seismograms caused by explosions 50–180m. distant from the point of observation were investigated and harmonic analysis was used to determine the periods of the pressure and shearing waves produced. It is shown that a better explanation can be obtained of processes occurring near the surface if not only the time of arrival but also individual phase movements are examined. This is especially true of later waves which are independent of the layers penetrated. It is shown that the true properties of the ground can thus be determined. R. S. R.

4875. Damping of Periodic Visco-Elastic Waves with Increase in Focal Distance. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 491–502, *Sept.*, 1938. *In English.*—Rayleigh waves, Love waves, and plane and radial bodily waves (dilatational and distortional) are discussed by treating the behaviour in transmission of a periodic visco-elastic wave whose amplitude at its source is constant. W. A. R.

4876. Formation of Boundary Waves at the Surface of a Discontinuity within the Earth's Crust. Part I. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 504–525, *Sept.*, 1938. *In English.*—The paper is a mathematical investigation of the way in which waves generated from a point source in the solid excite boundary waves at any discontinuous surface in the same solid. Distortional and dilatational primary waves are considered, and the problem is treated as involving two dimensions only. W. A. R.

4877. Three Dimensional Vibrations of a Framed Structure. K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 538–549, *Sept.*, 1938. *In English.*—In continuation of an earlier investigation a general solution is obtained for the three-dimensional vibration of a structure which in itself is apparently in a two-dimensional condition. This is found to depend upon certain conditions of the structure as well as the direction of movement of the seismic vibrations. The detailed nature of the vibrations for different cases has been considered. The mathematical results were confirmed by model experiments from which it was shown that in spite of the extremely complex forms of the mathematical solutions there was little error even in the numerical constants of the solutions. R. S. R.

4878. Origins of Earthquakes. W. Inouye. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 597–630, *Sept.*, 1938. *In English.*—The data regarding several deep-focus earthquakes are compared with the results of theoretical treatment of elastic waves assuming that both normal and tangential stresses change with a certain rapidity over a spherical cavity at the seismic focus. It is concluded that in such cases the stresses attain their final values in about the time taken by the waves to travel a distance equal to the radius of the seismic focus, their wavelengths being comparable thereto, while the range of stress changes at the focus is of the order of 10^6 dynes/cm². [See Abstract 1100 (1938).] C. A. S.

See also Abstracts 4854, 5077.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4879. Diurnal Variation of the Magnetic Pole. K. F. Wasserfall. *Terr. Mag.* 43. *pp.* 219–225, *Sept.*, 1938.—Mean values of the magnetic elements obtained by Amundsen at Gjoahavn for the year 1904 were used to plot the diurnal variation of the magnetic pole. This shows as an oval 22km. from E. to W. and 14 km. from N. to S. The results were compared with those at Dombas and Godhavn. The agreement between observation and theory supports the Chapman-Bartels theory that an electromagnetic current system exists in the ionised part of the atmosphere and that it is responsible for the main features of the quiet diurnal variation of the magnetic elements even for stations quite near the magnetic pole. It is also concluded that the diurnal variation of the magnetic pole is caused by this current system. R. S. R.

4880. Radiation of the Earth's Angular Momentum. T. Schlomka. *Ann. d. Physik*, 33. 3. *pp.* 259–264, *Oct.*, 1938.—The earth being a rotating magnet, the electromagnetic radiation from it must cause a reduction of the angular momentum. A calculation is made, using the known strength of the earth's magnetic field, to determine the increase in the length of the day due to this cause. It is found to be insignificant during geological time. G. C. McV.

See also Abstracts 4853, 4865, 5003.

RADIOACTIVITY.

4881. Naturally Radioactive Elements. W. Minder. *Helv. Phys. Acta*, 11. 6. *pp.* 497–506, 1938. *In German.*—In a hypothetical discussion of the mechanism of radioactive decay, the dependence of the neutron-proton ratio (A-Z)/Z on the atomic number is obtained for the various elements. A similarity is found to exist between the three decay series, *viz.*, U, Th and Pd. The total variation of the ratio (A-Z)/Z for the radio-active elements is found to lie in the range 1·50 to 1·61. Those elements with a high ratio are mostly β-radiators while those with low values are α-radiators. A suggestion is made with regard to the gaps at 85 and 87 in the atomic table. G. O. B.

4882. Existence of Thorium-Polonium. J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 3–4. *pp.* 161–179, 1938.—Using a valve amplifier and a differential ionisation chamber, an attempt was made to test the existence of Th-Po. No α-particle emission was observed and the half-life of one of the three bodies ThD, ThE or ThF would have to be greater than 10^{13} *y*. It therefore seems very improbable that Pb^{204}, found by the mass spectrograph, can arise entirely from the theoretically possible disintegration of ThD. F. C. C.

4883. Production of Long-Lived Radioactive Co Isotope from Ni Bombarded by Fast Neutrons. O. Viktorin. *Cambridge Phil. Soc., Proc.* 34. *pp.* 612–613, *Oct.*, 1938.—It is shown that a long-lived radioactive

Co isotope, which had been previously obtained by Livingood and Seaborg [*Phys. Rev.* 53. *p.* 847, *May* 15, 1938] by bombardment of Co with slow neutrons, can be produced by irradiation of Ni with fast neutrons.
AUTHOR.

4884. Disintegration of Carbon by Fast Neutrons. H. Aoki. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 755–756, *Sept.*, 1938.—Wilson chamber photographs of the result of bombarding C (present as CH_4 or vapour of EtOH) with neutrons from Li + D showed nine " tridents " in 910 pairs of photographs, while none were observed when the source of neutrons was D + D. Energy calculations favour the explanation that this is due to the reaction $^{12}C + {}^1n \rightarrow 3\,{}^4He + {}^1n$, rather than to $^{12}C + {}^1n \rightarrow 2\,{}^4He + {}^5He$. [See Abstract 3458 (1934).] C. A. S.

4885. Disintegration of Fluorine by α-Particle Bombardment. N. K. Saha. *Zeits. f. Physik*, 110. 7–8. *pp.* 473–494, 1938.—An account is given of a series of measurements made to determine the relation between the various disintegration processes produced in F when it is bombarded with α-particles from Po. The excitation curves for the production of protons, neutrons and γ-rays are shown and the resonance levels are determined for each process. The probability of the intermediate nucleus disintegrating with emission of a proton or a neutron is investigated. The total yield of neutrons appears to be about the same as that of protons and from this fact and other evidence it is deduced that the γ-ray emission is associated with the neutron emission as well as with the proton emission. The evidence indicates that the probability of γ-ray emission as a consequence of an inelastic collision between the incident α-particle and the F nucleus must be very much smaller than the probability of the other processes. The least energy which will cause neutron emission is found to be slightly less than that for proton emission. It is calculated that an upper limit for the mass of Na^{22} is $\overline{<}22\cdot0022$. J. E. R. C.

4886. Artificial Disintegration of Ne. K. Galler. *Zeits. f. Physik*, 110. 9–10. *pp.* 605–610, 1938.—By bombarding Ne with fast neutrons which possess a continuous energy distribution, α-particles are liberated whose energies are found to lie in discrete groups. The measured total energies, of α-particle and recoil nucleus, are 1·7, 2·4, 3·8, 4·8 and 5·3 eMV. These groups can be arranged as excitation states of the intermediate nucleus Ne^{21} which becomes Ne^{23}. Such an arrangement is not entirely satisfactory so long as it is not clear which excitation states of the final nucleus can result in the process. G. O. B.

4887. Angular Distribution in Nuclear Transitions. C. Reinsberg. *Zeit. f. Physik*, 110. 11–12. *p.* 765, 1938.—A correction. [See Abstract 1568 (1938).]

4888. Nuclear Transformations Produced in Zinc by α-Particle Bombardment. W. B. Mann. *Phys. Rev.* 54. *pp.* 649–652, *Nov.* 1, 1938.—Zn has been bombarded with 17 eMV α-particles and the consequent radioactivity observed. The disintegration products are mainly positrons; the half-lives of the observed activities are 19·8±0·4 min., 37±1·5 hr., 79±2 hr. and about 195 days. A chemical separation indicates that the first and third of these activities are due to Ga and the remaining two to Ge. The two Ga activities may be respectively assigned to Ga^{70} and Ga^{67}. No very definite assignment has been possible, however, with respect to the activities associated with Ge. AUTHOR.

4889. Nuclear Transmutations of Li Isotopes. L. H. Rumbaugh, R. B. Roberts and L. R. Hafstad. *Phys. Rev.* 54. *pp.* 657–680, *Nov.* 1, 1938.—Yield curves have been obtained for eight of the more important reactions of Li^6 and Li^7 produced by proton and deuteron bombardment in the energy range from 200 to 1000 ekV. Each curve was obtained with an accuracy of about 5%, and a set of intercomparisons served to determine the relative yields between the different reactions within 20%. A special set of observations on a single reaction then gave the absolute yield for all the reactions within a factor of about three. An investigation was made of the reactions involved in the formation and decay of Li^8, the mass of which was found to be $8 \cdot 02499 \pm 0 \cdot 00020$. The range-distribution of the delayed α-particles from Li^8 was measured and the interpretation of this distribution is discussed. Observations on the reaction $Li^6 + n \rightarrow He^4 + H^3$ gave a value of $4 \cdot 97$ eMV for the reaction energy as compared to a value of $4 \cdot 56$ eMV derived from the masses involved. No evidence could be obtained for the production of Li^8 by the process $Li^7 + n \rightarrow Li^8$. Measurements of the energies of the neutrons produced by deuteron bombardment of Li^6 indicated that Be^7 is formed by the reaction $Li^6 + D^2 \rightarrow Be^7 + n$. Further experiments showed that Be^7 is radioactive and is converted to Li^7 by K-electron capture. It was found that this process is followed by γ-ray emission in roughly 10% of the transitions. [See following Abstract.] AUTHORS.

4890. K-Electron Capture in Be^7. G. Breit and J. K. Knipp. *Phys. Rev.* 54. *pp.* 652–656, *Nov.* 1, 1938.—There is no observed positron emission in Be^7. This sets an upper limit of $2 \cdot 09\ mc^2$ for the mass difference Be^7–Li^7 from Fermi's theory and $2 \cdot 3\ mc^2$ from the Konopinski-Uhlenbeck theory. This upper limit is compared with other estimates of the same mass difference. The γ-ray emission accompanying the disintegration probably takes place after the *K* capture from an excited state of Li^7 having a spin $\frac{1}{2}$. The *K*-capture transition to $i = \frac{1}{2}$ from $i = \frac{3}{2}$ is according to experiment only $\frac{1}{10}$ as weak as that to $i = \frac{3}{2}$. This speaks for the Gamow-Teller type of selection rules. The mean lives of He^6, Be^7, C^{11} are compared. It is found that the observed mean lines are relatively shorter for the lighter nuclei than Fermi's theory predicts. This is in apparent contradiction with the preference shown for the Fermi theory by the α-particle distribution from Li^8. From a theory without derivatives, the facts seem to point either to an appreciable increase in the many-body aspect of nuclei from He^6 to C^{11} or else to a decrease in the intrinsic β-emitting powers of nuclear particles in heavier nuclei. On the Konopinski-Uhlenbeck theory some of the disagreement can be removed but the β-particle distribution from Li^8 (Gamow and Teller) speaks strongly against using this theory for mean lives. [See preceding Abstract.] AUTHORS.

4891. Decomposition and Synthesis of HI by α-Particles. K. G. Brattain. *J. Phys. Chem.* 42. *p.* 974, *Oct.*, 1938.—A correction. [See Abstract 3200 (1938).]

4892. α-Rays from Mesothorium 2. E. Rona and J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 1–2. *pp.* 49–62, 1938.—Using two different experimental arrangements, absorption curves are obtained which show that, in agreement with the results of Hahn and Rotenbach and in contradiction with those of Guében, mesothorium 2 emits no α-particles within an accuracy of an α-β branching ratio of 2×10^{-4}. F. C. C.

4893. Natural H-Rays. J. Riedl. *Akad. Wiss. Wien. Ber.* 147. 2*a*. 3–4. *pp.* 181–195, 1938.—By means of the photographic method, an investigation has been made of the energy spectrum of the protons liberated in a forward direction on bombardment of paraffin with Po α-rays. Both thick and thin paraffin layers have been used. Four range groups have been found, having the values 7·6, 10·1, 11·9 and 13·2 cm. in air. The first and fourth of these can be compared with the first two groups found by Frank. [See Abstract 4490 (1934).] G. O. B.

4894. Absorption Method of Investigating Primary β-Particles from Radioactive Substances. N. Feather. *Cambridge Phil. Soc., Proc.* 34. *pp.* 599–611, *Oct.*, 1938.—A detailed account is given of an absorption method, using the β-radiation of Ra E as a standard of comparison, by which the maximum energy and some indication of the form of the energy spectrum of the β-particles from any other radioelement may be obtained. The method is applicable alike to weak sources and to sources of finite thickness and is designed to yield the largest amount of information under such limitations. Experimental results with sources of UX_2, Na^{24}, Ag^{106} and P^{32} are treated by the method described. A modified empirical range-energy relation is given. [See also Abstract 3637 (1938).] AUTHOR.

4895. Application of Clay's New Value of the Jaffé-Zanstra Coefficient for Air to High Pressure Ion Current Measurements. J. W. Broxon and G. T. Merideth. *Phys. Rev.* 54. *pp.* 605–608, *Oct.* 15, 1938.—Clay [see Abstract 4338 (1935)] has found the coefficient $1 \cdot 24(10)^{-4}$ employed by Zanstra in his treatment of high pressure ionisation data for air by Jaffé's columnar theory, should actually be applied to N_2, and the coefficient 10^{-5} substituted in the case of air. The authors have used the new coefficient in a repetition of the analysis of their experimental data. The straight lines predicted by the theory are obtained in the collecting field range, 1769-4520V/cm, in most cases, and the curvatures of the Jaffé-Zanstra curves are lessened in the remaining cases. The curves obtained by plotting the theoretical "saturation" current values against the specific gravity of the air do not display the definite breaks indicated before. [See also Abstract 3203 (1938).] AUTHORS.

∗4896. Background Effect in Tube Counters. H. Osterwisch. *Phys. Zeits.* 39. *pp.* 661–665, *Sept.* 15, 1938.—Using a portable apparatus, the background count of tube counters of different dimensions was examined in a salt mine of depth greater than 1000m. water equivalent. Measurements were made on different days. The background was found to be constant under conditions of normal working of the counter to 10^{-4}Nsec^{-1} cm.$^{-2}$ or to about 1·6% of the average count inside 10cm. of Pb. This corresponds approximately to 0·7% of the normal radiation from the earth's surface. F. C. C.

∗4897. Counting Losses in Geiger-Müller Counter Circuits and Recorders. H. Lifschutz and O. S. Duffendack. *Phys. Rev.* 54. *pp.* 714–725, *Nov.* 1, 1938.—The counting losses due to the finite recovery time of Geiger-Müller counter circuits and recorders are investigated. A description and critique of several experimental methods are given. The parallel method reported here gives the most accurate results. By this method the counting losses in a system consisting of a Geiger-Müller counter coupled by means of a Neher-Harper circuit to a scale-of-one recorder were determined. The method compares the counts registered by the scale-of-one against those registered by a vacuum tube scale-of-128 in parallel with it. The resolution times of both the scale-of-one and the G-M, Neher-Harper combination are thus found. The theoretical equations of Ruark and Brammer and Aloaglu and Smith are verified. The limitations and applicability of the Schiff-Volz formulation are also determined. Departures from the Ruark-Brammer formula for the Neher-Harper circuit are found at high counting rates. A corrected formula is derived. The speed of the Neher-Harper type of extinguishing circuit, determined in these experiments, is compared with the maximum counting speed possible with G-M counters. It is found that such circuits already approach the speed of the G-M tube itself. Existing vacuum tube scaling circuits and frequency meters are shown to be already faster than the G-M tube itself. The methods for correcting recorders and counter circuits for counting losses are given. These losses amount to about 20% for a Cenco recorder and 1% for most G-M counters at input rates of 1000 counts per min. The losses increase rapidly with the input counting rate. AUTHORS.

***4898. Counter Circuit for D.C. Mains. C. B. Madsen.** *Journ. Sci. Instruments,* 15. *p.* 373, *Nov.,* 1938.—The diagram and working of a simple counter circuit for d.c. mains, employing two triode valves, is described. The values of the components are given for d.c. mains of 220 V. AUTHOR.

***4899. Production of High-Energy Particles. W. H. Wells.** *J. of Applied Physics,* 9. *pp.* 677–688, *Nov.,* 1938.—A review of the recent progress in the development of extremely high voltages.

***4900. Cyclotron and its Applications. J. Chadwick.** *Roy. Inst., Proc.* 30. 2. *pp.* 398–399, 1938. *Nature,* 142. *pp.* 630–634, *Oct.* 8, 1938. *Abstracts.*—The principles governing the operation of the cyclotron for accelerating ions are discussed and a description is given of the apparatus under construction for Liverpool University. Applications of the cyclotron to physical and biological researches are reviewed. The former researches are directed to the study of atomic nuclei, and the latter to the effect of neutrons on malignant tissues. The use of radioactive elements, produced by the cyclotron, as radioactive indicators in biological investigations is also discussed. R. D.

***4901. Paths of Ions in the Cyclotron. Part I. Orbits in the Magnetic Field. Part II. Paths in Combined Electric and Magnetic Fields. L. H. Thomas.** *Phys. Rev.* 54. *pp.* 580–598, *Oct.* 15, 1938.—Bethe and Rose maintain in a recent letter [*ibid.* 52. *p.* 1254, *Dec.* 15, 1937] and paper [see Abstract 1964 (1938)] that a maximum energy for the beam from a cyclotron is fixed by the incompatibility of the conditions for resonance and focusing when the relativity increase of mass with velocity is taken into account. It is shown in Part I that, while this result holds for a radially symmetrical magnetic field, it is not necessarily true in general; and that for a field varying with polar angle there is an additional focusing effect. If the relative variation of the field with polar angle is of the order of the ratio of the velocity of the ion to the velocity of light, this focusing effect will compensate the defocusing effect of Bethe and Rose. It is shown further than if this variation has period $\pi/2$, a family of stable periodic orbits exists which are nearly concentric circles. In Part II it is shown that the effects of variation with polar angle of the accelerating electric field and of the magnetic field can be considered as almost independent; the second-order cross terms between them are without practical effect. Thus the results contained in Part I may simply be superposed on those obtained by other workers. AUTHOR.

***4902. Present-Day Design and Technique of the Cyclotron. F. N. D. Kurie.** *J. of Applied Physics,* 9. *pp.* 691–701, *Nov.,* 1938.—A description of the methods and application of the cyclotron as developed by E. O. Lawrence and his associates at the Radiation Laboratory, University of California, Berkeley.

See also Abstracts 4735, 4789, 4814, 4852, 4973, 5055.

RADIATION.

ABSORPTION.

4903. Colour and Chemical Constitution of Salts of Diphenyl Violuric Acid. S. Prakash and S. Dutt. *Nat. Acad. Sci. India, Proc.* 8. *pp.* 29–39, *June,* 1938.—Diphenyl violuric acid is pale yellow as solid or dissolved in non-hydroxylic solvents, but the salts produced by adding alkalies or organic bases are intensely violet. This change is shown to be associated with a transition from an oximino-ketonic to a nitroso-enolic molecular structure. Study of absorption spectra and hydrolysis constants of the salts shows that the colour is roughly proportional to the strength of the base involved. C. B. A.

See also Abstract 5078.

COLORIMETRY.

***4904. Artificial Daylight. R. Toussaint.** *Soc. Franç. Élect., Bull.* 8. *pp.* 875–878, *Oct.*, 1938.—The author points out that the first step in the production of an artificial daylight is to argee upon the form of daylight to be imitated. He proposes a spectral distribution midway between that of a clear blue sky and that of an overcast sky. He then describes a form of lamp in which the required spectral distribution is obtained by mixing the lights transmitted through three colour filters, one blue+violet (6 parts), one yellow+green (2 parts), and the third orange+red (1 part). Adjustment to correct proportions in the mixture is effected by means of a photo-cell. J. W. T. W.

See also Abstract 4921.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4905. Magneto-Optic Rotations of Paramagnetic Ions. S. Steingiser and H. Hyman. *Am. Chem. Soc., J.* 60. *pp.* 2294–2296, *Oct.*, 1938.—The partial Verdet constants of ferric ammonium sulphate, potassium ferricyanide and potassium ferrocyanide were determined and found to be equal to − 1·024, − 2·354 and + 0·148, at molalities 0·0282, 0·173 and 0·415, respectively. The total Verdet constant for each of these molalities was found to be 0·01253, 0·00571 and 0·01409, respectively. The diamagnetic salt, potassium ferrocyanide, shows a normal rotation, while the other salts show a large negative rotation, due to paramagnetism. AUTHORS.

See also Abstract 5037.

EMISSION.

4906. Definition of the Neutrino. J. Solomon. *Comptes Rendus,* 207. *pp.* 526–528, *Sept.* 26, 1938.—A mathematical consideration of the interaction of the systems (nucleus+emitted electron) and (neutrino)

indicates that the theory of β-disintegration implies, not the existence of a new particle or neutrino, but simply a certain number of structural properties of the adjacent system necessary to conserve the total system.
N. M. B.

4907. Researches on Cosmic Rays, 1933-1938. R. Steinmaurer. *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 38–112, 1938.—Review of recent work in this subject, containing a Bibliography of 1017 references.

4908. Cosmic-Ray Showers and Bursts. D. K. Froman and J. C. Stearns. *Rev. Modern Physics,* 10. *pp.* 133–192, *July,* 1938.—This paper is a comprehensive survey of existing experimental knowledge and theoretical deductions therefrom. D. H. F.

4909. Penetrating Power of Cosmic-Ray Shower Particles. L. Jánossy. *Cambridge Phil. Soc., Proc.* 34. *pp.* 614–619, *Oct.,* 1938.—The absorption curve for cosmic-ray shower particles has been observed in Pb and Fe with a counter arrangement. Since the observed curves are in good agreement with the absorption curve of cosmic-ray electrons calculated by Heitler, it has been concluded that nearly all the showers are of the cascade type. Observations of Schmeisser and Bothe [see Abstract 2423 (1938)], which have previously been interpreted as giving experimental evidence for the occurrence of penetrating particles in showers are not in contradiction with the observations given here, so that they also must be interpreted in terms of energetic electron cascades. AUTHOR.

4910. Ray Multiplication in Cosmic-Ray Showers. H. Geiger and M. Heyden. *Zeits. f. Physik,* 110. 5–6. *pp.* 310–319, 1938.—By coincidence-counter experiments it is shown that the mean number of rays in a shower depends in a definite way on the thickness of the lead sheet from which it emerges. The curves obtained indicate that the number of rays in a shower increases considerably with the lead thickness up to 3cm. but with greater thickness slowly decreases. Also with Al layers the initial increase with the layer thickness is established. The Rossi coincidence-curve is discussed in the light of the new results. The increase in the coincidence number up to 1·5cm. Pb is not to be ascribed to an increase in the number of showers but to an increase in the number of rays in a shower. C. J. B. C.

4911. Energy Loss of Cosmic Rays in Penetrating 9cm. of Gold. P. Ehrenfest, Jr. *Comptes Rendus,* 207. *pp.* 573–576, *Oct.* 3, 1938.—Measurements were made with a counter-controlled double cloud-chamber, with a 9cm. block of Au between the two compartments, in a magnetic field; the whole assembly was covered by a 16cm. Pb screen. The energy loss of particles ranging from about 10^8 eV up to about 10^{10} eV was measured The results are briefly discussed. The presence of particles losing little energy in passing through the Au is indicated. It is pointed out that the results are not wholly in accord with those of Blackett and Wilson. [See Abstracts 3071 (1937) and 2856 (1938).]
D. H. F.

4912. Counter Systems for Measuring Cosmic Rays of Very Small Intensity. A. van Gemert. *Physica,* 5. *pp.* 811–816, *Oct.,* 1938. *In English.*—Two diagrams of counter systems are given for measuring very small intensities of cosmic radiation. The first system was used for measurements in water down to 440m. in a fjord near Bergen, the second system is used for measuring the intensity of the radiation by triple coincidences in a colliery down to 620 m. (about 1600 m. water equivalent). In the first case a value was obtained with an uncertainty of 8% in 12 hr. at 440m. and in the second case an uncertainty of 4% in 20 days at 500m. (about 1300m. water equivalent). AUTHOR.

4913. Absolute Intensity of Cosmic Rays at Sea Level. J. Clay and P. H. Clay. *Physica*, 5. *pp.* 898–900, *Oct.*, 1938. *In English.*—The intensity of cosmic radiation was measured in an ionisation chamber of 28 l. filled with argon at 61 atm., exactly at a level with the surface of the sea in a Norwegian fjord 58° N.L. With the same chamber the intensity was measured in Amsterdam in an iron shield 22 cm. thick underneath and at the sides and 12 cm. at the top. The experiment was carried out in the same shield and in the same place where the absolute intensity was measured before (independent of shape and dimensions of the chamber). The value at sea level for magnetic latitudes $>$ 50° is in argon at 1 atm. and 15° C. 2·24 ± 0·06 I; in air at 1 atm. and 15° C. 1·56 ± 0·05 I with a barometer reading of 770 mm. Hg. For 760 mm. Hg it is 5% more. AUTHORS.

See also Abstracts 4844, 4904, 5053.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4914. Fluorescent Chromium Ion in Ruby. B. V. Thosar. *Phil. Mag.* 26. *pp.* 878–887, *Nov.*, 1938. *Supplement.*—Further support is found for the author's idea [see Abstract 4090 (1938)] regarding the physical state of the Cr impurity in ruby, namely, that the fluorescent ions of Cr are regular lattice components and replace a few Al-ions of the corundum lattice. The intense anti-Stokes bands in the spectrum of ruby have been explained as due to the superposition of the vibrational frequencies of the molecular group Cr_2O_3, which is thus formed in the crystal. On postulating a weak L-S interaction in the ion and adopting the above structure for ruby, the magnetic dissymmetry in the crystal, in regard to the Zeeman pattern of the sharp lines, has been explained. The validity of the inner quantum number J and the spin-multiplicity have been discussed. Two sharp lines at 7017 and 7049 Å, hitherto unexplained, are shown to arise from the transitions between the newly determined ^{4}P levels of CrIV and the ^{4}F levels. AUTHOR.

See also Abstract 4923 and

3547B. Low Pressure Mercury Discharge within Luminescent Tube. W. Uyterhoeven and G. Zecher.
3548B. Fluorescence and Phosphorescence. J. H. Gisolf and W. de Groot.
3549B. Light Production by Luminescent Materials. A. Rütternauer.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***4915. Photographic Photometry of Interference Fringes. J. Roig.** *Rev. d'Optique*, 17. *pp.* 177–192, *May, and pp.* 217–238, *June–July*, 1938.—A detailed exposition of the principles of photographic photometry as applied to such problems as the study of interference fringes. The author uses for calibrating his emulsion a light source which is varied in intensity by means of a polarising prism and analyser. The various sources of error are dealt with *seriatim* in detail. Details are also given of the monochromator used for the work. J. W. T. W.

***4916. Diffraction by Irregular Gratings. R. W. Ditchburn.** *Roy. Irish Acad., Proc.* 44A. *pp.* 123–138, *July*, 1938.—The properties of gratings in which the distance between successive lines is not constant, but is a multiple of some fundamental length, are discussed. It is suggested that some gratings of this type may be of practical importance, because with such gratings it is possible to obtain a ratio of resolving power to lines ruled which is considerably higher than the corresponding ratio for equal space gratings. If the irregular grating is well designed this increase in resolving power does not involve the production of large secondary maxima or cause any other unfavourable changes in the properties of the grating. The system is specially applicable to echelon diffraction gratings. Two designs for echelon diffraction gratings and one for a ruled grating are given. The general problem of design is also discussed. AUTHOR.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4917. Mercury Photosensitised Decomposition of Ethane. E. W. R. Steacie, W. A. Alexander, and N. W. F. Phillips. *Canad. J. of Research*, 16. *Sect. B. pp.* 303–318, *Sept.*, 1938.—[See also Abstracts 1998 and 4077 (1938).]

4918. Competition of Predissociation Processes in the Photolysis of Polyatomic Molecules. G. K. Rollefson and M. Burton. *J. Chem. Phys.* 6. *pp.* 674–679, *Nov.*, 1938.—It is shown that if a photo-activated polyatomic molecule may decompose in more than one way with different products for each path, certain generalisations govern the probability of an activated molecule decomposing by any given path. First, there is a tendency to form those products which require a minimum amount of the activation energy to appear as kinetic energy. This tendency increases with increase in energy of the molecule if the energies at which the different paths become possible are widely separated but the opposite effect is found if the separation is small. The effects of collisions in causing predissociation is shown to be interpretable partially as an alteration of the number of times that the molecule reaches a condition represented by the intersection of two hypersurfaces and partially as a disturbance of the restrictions existing at such crossings. These principles are applied in a discussion of the photolyses of acetone, acetaldehyde, acetic acid, formic acid, and normal butyraldehyde. [See also Abstract 3679 (1938).] AUTHORS.

4919. Photolysis of ND_3. M. Burton. *J. Chem. Phys.* 6. *pp.* 680–681, *Nov.*, 1938.—In order to avoid theoretical objections to the mechanism previously suggested for the photolysis of ND_3, a new mechanism is proposed involving competition between two spontaneous predissociation processes in the discrete region. The relative amounts dissociating by the two paths, one yielding H and the other H_2, are shown to be in the approximate ratio 19 : 1 in the primary act. In the diffuse region, the time of decomposition is so short that the reaction is exclusively by the first path. AUTHOR.

See also Abstracts 4925, 4973.

PHOTOMETRY.

4920. Theory of the Luminous Field. A. Gersun. *R.G.E.* 44. *pp.* 307–312, *Sept.* 10, 1938.—Blondel's criticisms [see Abstract 181 (1938)] of the theory of the luminous field are refuted. *Reply by* **A. Blondel** (*ibid., pp.* 312–317).

4921. Problems of Photometry and Colorimetry. J. Dourgnon. *Soc. Franç. Élect., Bull.* 8. *pp.* 887–898, *Oct.*, 1938.—Outlines the principles of photometry and shows how the problem of heterochromatic measurements is solved by the use of the international visibility (luminosity) factors. In colorimetry the I.C.I. system is explained and the standardisation of a hypothetical observer's characteristics is shown to provide a basis for a universal system of colour measurement. The hue-and-saturation system is also described. J. W. T. W.

***4922. Photometry of Projection Apparatus at Short Distances. A. Marsat and P. Cibié.** *Soc. Franç. Élect., Bull.* 8. *pp.* 869–874, *Oct.*, 1938.—Describes the application of the method of photometry of projectors proposed by Blondel [see Abstract 3543 (1929)]. This involves the use of a converging lens or mirror of long focal length and of a diameter slightly greater than that of the projector to be measured to throw an image of the projector on a screen placed a short distance away. By the use of a screen perforated with a small hole it is possible to examine the appearance of the projector as seen from a point corresponding to the position of the hole but placed at a much greater distance from the projector. In other words, the appearance of the projector at long ranges can be simulated at a short range by means of this device. The application of the method to motor-car headlights is described, both for the case in which a converging lens is used and that in which a concave mirror is employed to form the first image. J. W. T. W.

***4923. Automatic Intensity Recorder for Photon Counters. M. Kato.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 817. *pp.* 981–990, *Sept.*, 1938. *In English.*—Describes a photon counter developed for use in investigating the phosphorescent properties of the alkali halide phosphors where a high speed of counting and a long recording apparatus is required. The equipment combines the Wynn-Williams automatic counter with the principle of frequency measurement. Time delays consequent upon the use of photographic recording are avoided by using a spark recorder. The range of the apparatus can be adjusted between several counts per min. and 250 counts per sec. E. O. T.

See also Abstracts 4915, 5079.

POLARISATION.

4924. Relative and Absolute Configuration of Complex Tridiammino-Ions of Trivalent Cr, Co and Rh. F. M. Jaeger. *Göttingen Nachrichten, Fachgruppe III.* 1. 20. *pp.* 199–213, 1937.—Data are given of an investigation into the optical rotation of solutions of a large number of complex tridiammino-ions of trivalent Cr, Co and Rh. Curves are given showing the relation of molecular rotation to wave-length. The results are discussed in relation to the spatial configuration of the ions. J. J.

4925. Photodichroism of Cyanine. S. Nikitine. *Comptes Rendus,* 207. *pp.* 462–464, *Sept.* 5, 1938.—The theory previously given [see Abstract 2875 (1938)] is tested by exposing to white light cyanine in collodion deposited on plates. The dichroism and absorption were measured by monochromatic light near the maximum of the absorption band. The results agree with theory, ϵ, the measure of the anisotropy of the absorption, being about 0·3. H. G. C.

***4926. Polarisation Microscopy with Bravais Double-Plates of Cellophane. H. Pfeiffer.** *Kolloid Zeits.* 85. *pp.* 49–52, *Oct.*, 1938.—The replacement of the polarising nicol commonly used in polarisation microscopy by an apparatus consisting of cellophane foils used like Bravais' double-plates is described. The apparatus is of use in determining the double refraction of biological material, and its variation with temperature. A. J. M.

***4927. Polarising Microscope for Investigating Prepared Jewels. W. Maier.** *Zeits. f. Instrumentenk.* 58. *pp.* 457–458, *Nov.,* 1938.—A description is given of a special type of polarising microscope used in the examination of jewels set in rings. Sectional drawings illustrate its use. It serves as an alternative to the instrument used in mineralogy and petrography. R. S. R.

See also Abstract 4930.

REFLECTION, REFRACTION AND DISPERSION.

***4928. Dioptrics of Aiming Telescope. H. Schulz.** *Zeits. f. Instrumentenk.* 58. *pp.* 452–455, *Nov.*, 1938.—Formulæ are derived for the constructional data by which the focal length and distance of the individual systems are determined depending upon the magnification, size of building, field of view, etc. According to the choice of the main conditions different groups of values are given which cannot always be brought into agreement with one another. R. S. R.

4929. Glass Estimation for Achromatic Lenses. H. Schulz. *Zeits. f. Instrumentenk.* 58. *p.* 412, *Oct.*, 1938.—It is shown that in determining the constants of an achromatic combination the refractive index of one glass is given as the root of a quadratic equation whose coefficients must be evaluated with considerably greater accuracy than usual, so that five-figure logarithms are in general not sufficiently accurate. A. W.

4930. Birefringence of Quartz under Compression and its U.V. Dispersion. G. Bruhat and A. Blanc-Lapierre. *Rev. d'Optique,* 17. *pp.* 137–160, *April,* 1938.—Three cases were investigated (1) compression parallel to the optic axis, propagation of light perpendicular to it (2) compression perpendicular, propagation parallel to the optical axis (3) compression and propagation normal to each other and to the optical axis. In case (2) the birefringence is about 28% less than in (1) and (3). In case (3) the effect is independent of the orientation of the pressure in relation to the electric axes. The dispersion agrees with Havelock's formula only to a first approximation. H. G. C.

4931. Refraction, Dispersion, and Related Properties of Pure Hydrocarbons, Arranged for Use in the Analysis of Hydrocarbon Mixtures. A. L. Ward and S. S. Kurtz, Jr. *Indust. and Engin. Chem.* (*Analytical Edition*), 10. *pp.* 559–576, *Oct.* 15, 1938.—The data tabulated are (1) boiling point at 760 mm. (or 10 mm.) ; (2) density d_4^{20} ; refractive index n_D^{20} ; (3) dispersion $n_F - n_C$ and two derived constants; (4) the refractivity intercept, $n - d/2$ (88) ; and (5) the specific dispersion $(n_F - n_C)/d$ (155). These are first tabulated in detail for ten classes of hydrocarbons ; tables containing averaged data for specified boiling ranges are then presented, and graphs are drawn based on these averaged properties. A few graphs are also presented showing the relationship between density and refractive index for groups of paraffin and olefin isomers. AUTHORS.

***4932. Lens Testing Bench. J. L. Houghton and E. W. H. Selwyn.** *Journ. Sci. Instruments,* 15. *pp.* 367–373, *Nov.*, 1938.—A lens bench is described which is suitable for the visual examination of photographic lenses of focal lengths from 0 mm. to 150 mm. over fields of view up to a total angle of 90°. In the middle of the bed, which is of channel section, is a turntable supporting the nodal slide and lens support. No means are at present provided for centring the lens under test, which is examined in the position it will occupy when mounted on a camera. The turntable is mounted on a ball-bearing cone. The microscope is coupled to the turntable by a T-bar which provides an automatic flat-field mechanism. The microscope is mounted upon slides of kinematic design, and its movements are controlled by two micrometer screws. The microscope tube is "bent" for ease of observation by the interposition of a stainless steel mirror. A set of parfocal objectives for use without cover glasses is provided. A micrometer, the range of which is extended by the use of gauge rods, is used to measure equivalent and back focal lengths, the end of the T-bar being used as reference point. The testing and adjustment of the various components is described in detail. AUTHORS.

See also Abstracts 4922, 4927, 4947, 4967, 5037, 5078.

SPECTROSCOPY.

4933. Fine Structures of Hα and Dα Under Varying Discharge Conditions. R. C. Williams. *Phys. Rev.* 54. *pp.* 558–567, *Oct.* 15, 1938.—The fine structures of Hα and Dα have been observed under varying conditions of excitation in the discharge tube with pure H_2 and pure D_2 maintained in each case at near liquid-air temperature, and with the aid of a Zeiss triple-prism spectrograph and a pair of Hilger quartz interferometer plates. The interference patterns obtained upon the photographic plates were analysed with a Moll microphotometer. The microphotometer curves were reduced to intensity curves and to linear dispersion curves in the usual manner. From the final reduced curves analyses were made of the intensities and positions of the fine structure components. Within the limits of error of the observations the positions of the fine structure components were found to be invariant with changing discharge conditions. The average interval between the two main components of the complex was found to be $0\cdot319\text{cm}^{-1}$ for Hα and $0\cdot321\text{cm}^{-1}$ for Dα. The second and third most intense components were optically resolved from each other in Dα but not in Hα. The average interval between these components was found to be $0\cdot130\text{cm}^{-1}$. According to theory these intervals are respectively $0\cdot328\text{cm}^{-1}$ and $0\cdot108\text{cm}^{-1}$. [See Abstract 5049 (1938).] AUTHOR.

4934. Isotope Effect in Line Absorption Spectrum of Uranyl Nitrate. G. Joos and B. Duhm. *Göttingen Nachrichten, Fachgruppe II.* 2. 9. *pp.* 123–126, 1936.—The displacements of absorption lines of $UO_2\,(NO_3)_2\cdot 6H_2O$ due to replacement of H by D are measured at temperatures of 20°Abs, and 83°Abs. All lines are displaced towards shorter wave-lengths by 2Å on the average. The separation of about 718cm^{-1} between homologous lines of individual groups remains unchanged. This frequency is ascribed to the $(UO_2)^{++}$ ion. The distances between lines of a given group decrease to a small extent, the separations between lines are ascribed to a vibration between the $(UO_2)^{++}$ ion and the neighbouring H_2O molecule. A common blue displacement of all lines is observed due to change of temperature from 20° to 83°Abs. All observed displacements are much smaller than in the case of chrome alum previously investigated by the authors [see Abstract 196 (1936)] in which the absorption was due to an atomic ion. J. E. K.

4935. Infra-Red Absorption of Atmospheric Water Vapour. W. M. Elsasser. *Monthly Weather Rev.* 66. *pp.* 175–178, *June*, 1938.—

This continues previous work [see Abstract 1185 (1938)]. Having given an expression for the intensity distribution in a spectral line the author proceeds to find an expression for the fractional absorption due to a single spectral line in a layer of finite thickness. When dealing with the numerical determination of the absorption the spectrum is divided into three parts, (1) from the short end to about 10μ, (2) from 10μ to 20μ, (3) from 20μ upwards. Each group is treated separately. In regions (1) and (3) the absorption follows a square root law, *i.e.* it is proportional to the square root of the optical thickness measured in gm. of precipitable water. The relationships between wave numbers and logarithms of absorption for these regions are shown by diagram. In the middle region the absorption follows an exponential law. This type is preponderant in the spectral range covered by atmospheric radiation. A. E. M. G.

4936. Near Infra-Red Spectrum of Cadmium. O. Masaki and K. Kobayakawa. *Hirosima Journ. Sci.* 8. *pp.* 289–291, *Aug.*, 1938. *In English.*—Using the Eastman new infra-red 1-Z plates spectrograms are obtained of the CdI spectrum which extend the photographically surveyed region from 10,000 to 12,000 Å. All the lines observed, save a few attributable to Cd II, are classified into series. A. H.

4937. Long-Wave Infra-Red Spectrum of Quartz-Mercury Lamps. B. Koch. *Ann. d. Physik*, 33. 4. *pp.* 335–358, *Oct.*, 1938.—The long wave infra-red spectra of different types of Hg lamps have been measured using laminar gratings and the effects (i) of operating conditions on radiation intensity and (ii) of the grating characteristics on the intensity distribution in the spectrum have been investigated. Transmissivities of molten quartz from 220-450μ and of LiF from 220-360μ have been determined. The absorption of Hg radiation by a second Hg arc, the emission of a Hg arc in relation to black-body emission, and the initial nature of the radiation are discussed. W. R. A.

4938. Hyperfine Structure of Os Lines. T. Kawada. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 653–655, *Aug.*, 1938. *In English.*—The h.f.s. of 3 OsI lines $\lambda\lambda 4420 \cdot 6$, $4261 \cdot 0$ and $4135 \cdot 9$ having a common $d^6s^2\,{}^5D_4$ level is measured with a Lummer plate and Fabry-Perot etalon. The spectrum being excited in a water-cooled Schüler hollow kathode tube. The observed structures are ascribed to the separated lines of the even isotopes of Os, namely Os^{192}, Os^{190}, Os^{188} and Os^{186} together with two components due to O^{189}. From the intensity and separation of the components ascribed to O^{189} it is concluded that this isotope has a nuclear moment of $I = \frac{1}{2}$ or $\frac{3}{2}$, the former value being the more probable. J. E. K.

4939. Wave Functions and Potential Curves for Excited H_2. A. S. Coolidge and H. M. James. *J. Chem. Phys.* 6. *pp.* 730–734, *Nov.*, 1938.—Results on wave functions and energy values for the $1s\sigma 2p\sigma\,{}^3\Sigma_u$ and $1s\sigma 2s\sigma\,{}^3\Sigma_g$ states of H_2, obtained by a variational method, are given. The nuclear separations considered range from $1 \cdot 3a_H$ to $2 \cdot 9a_H$. The errors in the computed energies for the ${}^3\Sigma_u$ state are of the order of $0 \cdot 001$ atomic unit, while the computed energies for the ${}^3\Sigma_g$ state are in general more accurate. Root-mean-square errors in the wave functions are of the order of 2%. AUTHORS.

4940. Extension of Theory of Complex Spectra. G. H. Shortley and B. Fried. *Phys. Rev.* 54. *pp.* 739–748, *Nov.* 1, 1938.—This paper extends the tabular and formular material of the theory of complex spectra to configurations involving *f* and *g* electrons. In making these computations it was found that in practically every case significant simplification could be made over the methods previously used. In particular, for the computation of the electrostatic energies for two-electron-like almost-closed-shell configurations a simple closed formula was found which entirely replaces the previous lengthy diagonal-sum calculation. The explicit content of the paper is best exhibited by listing the section headings: (I) Extension of tables of c^k, b^k, and a^k to *gp, gd, gf, gg*; (II) explanation of the regularities in the electrostatic energies of two-electron configurations and formulæ for *gp, gd, gf, gg*, g^2; (III) formula determining the electrostatic energies of two-electron-like configurations with almost-closed shells; values for p^5g and d^9g; (IV) matrices for transformation of *pf, df, pg, dg* from LS to *jj* coupling; (V) matrices of electrostatic interaction in *jj* coupling for p^5f, (d^9p), d^9d, d^9f, d^9g. AUTHORS.

4941. Structure of Configurations of High Azimuthal Quantum Number in Cu II and Rare Gases. G. H. Shortley and B. Fried. *Phys. Rev.* 54. *pp.* 749–753, *Nov.* 1, 1938.—The energy levels of configurations such as d^9f, d^9g of Cu II and p^5d, p^5f of the rare gases are split into two widely separated groups by the spin-orbit interaction of the almost closed shell. These groups have the two levels of the parent doublet as limits. The splitting within these groups is due to the small electrostatic interaction between the core and the outer electron and the spin-orbit interaction of the outer electron. It is found that if one neglects all of these except the leading term in the electrostatic interaction, the theory predicts that all levels should be double, two levels of different J value having the same energy. It further predicts definitely, without unknown constants, all details of the relative arrangement of these energy levels in the two groups. In the rare-gas configurations and Cu II d^9f, the levels tend to occur in these pairs and follow this arrangement approximately but the interactions which are neglected in this picture are not entirely negligible. Knowledge of the simple limiting structure should nevertheless be of value in such cases. Cu II $3d^95g$ however fits the simple picture in all details; the levels are observed to occur in pairs with precisely the energies predicted. Thus the 20 levels of this complex configuration are represented by simpler formulæ and with better agreement ($0 \cdot 20$ cm^{-1}, average discrepancy) than in any other case which has been treated theoretically. AUTHORS.

4942. Infra-Red Spectrum and Structure of Glasses. F. Matossi. *Helv. Phys. Acta*, 11. 6. *pp.* 469–471, 1938. *In German.*—Reference is made to previously recorded investigations [see Abstract 2032 (1938)], and the structure of glasses is discussed. For the atomic structure of quartz-glass and possibly for all melted crystal glasses the following picture may prove true: Small quasi-crystalline regions exist which are connected to each other by transition zones, in which zones the network view may hold good, yet not for the whole structure. The network hypothesis of Zachariasen may then hold if a quasi-crystalline structure is assumed. On one hand the rejection of the extreme network hypothesis is supported by X-ray investigations. On the other hand fluorescence observations show that an extreme crystallite structure is impossible since crystals and glasses actually possess different fluorescence spectra. J. J. S.

4943. Vibrational-Rotational Radiation Transitions in Water Molecules in Non-Polar Solvents. J. W. Ellis and E. L. Kinsey. *Phys. Rev.* 54. *pp.* 599–601, *Oct.* 15, 1938.—The $1 \cdot 875\mu(\sigma + \delta)$ and $1 \cdot 379\mu(\sigma + \pi)$ absorption bands of H_2O molecules in CCl_4 and CS_2

solutions and the $1 \cdot 985\mu(\sigma + \pi)$ band of D_2O in CCl_4 are presented. They are interpreted as indicating free rotation of water vapour-like molecules in solution. The dominant feature of each band is an enhanced Q-branch. The authors are unable to decide to what extent this enhancement is caused by a possible departure from the usual rotational distribution characteristic of vapours and to what extent by possible alterations in transition probabilities. [See also Abstract 3589 (1937).] AUTHORS.

4944. Infra-Red and Raman Spectra of Ethane. B. L. Crawford, Jr., W. H. Avery and J. W. Linnett. *J. Chem. Phys.* 6. *pp.* 682–685, *Nov.*, 1938.—The Raman and infra-red spectfra of ethane have been re-examined. The 993, 2900, and 2955 cm^{-1}. Raman lines are polarised; there were indications of very faint lines appearing at 620 and 820 cm^{-1}. The strong infra-red peak at 1480 cm^{-1}. is found to be a *single* minimum; the weak band at 1740 cm^{-1}. is confirmed. The available Raman and infra-red data are evaluated, and possible assignments discussed. It is shown that the observed frequencies do not require a 740 cm^{-1}. fundamental, but are consistent with an "uncertain frequency" of about 1100 cm^{-1}. and a high restricting potential. [See Abstract 2463 (1938) and following Abstract.] AUTHORS.

4945. Infra-Red and Raman Spectra of Allene. J. W. Linnett and W. H. Avery. *J. Chem. Phys.* 6. *pp.* 686–691, *Nov.*, 1938.—The infra-red absorption spectrum and the Raman spectrum of allene were examined. In the infra-red nine bands were observed at 4200, 2960, 2420, 1980, 1700, 1389, 1165, 1031 and 852 cm^{-1}. and in the Raman effect there were ten individual shifts of 3062, 2992, 2858, 1956, 1684, 1430, 1069, 838, 705 and 353 cm^{-1}. With the aid of heat capacity data it was possible to assign values to the frequencies of all the eleven fundamental modes of vibration of allene. The assignment accounted for all the features of the Raman and infra-red spectra. Calculations were made of the free energy, the entropy and the heat capacity and expressions for the first two, as functions of temperature, derived. [See preceding and following Abstracts.] AUTHORS.

4946. Infra-Red and Raman Spectra of Cyclopropane and Ethylene Oxide. J. W. Linnett. *J. Chem. Phys.* 6. *pp.* 692–702, *Nov.*, 1938.—The Raman and infra-red spectra of cyclopropane and ethylene oxide have been examined. The infra-red spectra were examined using a KBr prism from 25 to 11μ, a rock-salt prism from 15 to 7μ and a fluorite prism from 8 to $1 \cdot 5\mu$. Because of the greater dispersion of fluorite more bands than had previously been observed were resolved in the region in which this prism could be used. The nature, symmetry and selection rules of the vibrations of these two molecules are summarised. It was found possible to make a complete assignment of the fundamental frequencies of cyclopropane which accounts for all the features of the spectra. With ethylene oxide it was only possible to make a partial assignment. The frequencies of the corresponding fundamental modes of vibration of the two molecules are compared. On the basis of the frequency assignment described, values for the free energy, entropy and heat capacity of cyclopropane are calculated between 100° and 1000° K. [See preceding Abstract.] AUTHOR.

4947. Molecular Spectra of Halides of the Iron Group especially FeCl. E. Miescher. *Helv. Phys. Acta,* 11. 6. *pp.* 463–468, 1938. *In German.*—FeCl shows an 8-group system in its spectrum between 3700 and 3300 Å, only one group of which is completely resolvable. This contains 6 intense bands forming the (0,0) band, and other bands of $\Delta v = 0$ sequence. The weaker adjacent bands represent the sequences $\Delta v = \pm 1, \pm 2$. FeBr gives one band system (3750–3600 Å) which is observed also in the spectrum of $FeBr_2$ vapour. The vapours of $FeCl_2$, $CoCl_2$ and $NiCl_2$ show isolated absorption continua in the near u.v., and an increasing absorption in the far u.v. $NiCl_2$ shows no decrease of absorption when examined at temperatures between 800° and 1000° at constant pressure, and the absorption is therefore due to the triatomic molecule. In $FeCl_2$, however, a second absorption maximum is observed at short wave-length. This is probably due to a dissociation process. W. R. A.

4948. Influence of Temperature on Absorption Spectra of Solid Solutions of Samarium. O. Blank. *Acta Physicochimica*, 9. 1. *pp.* 103–110, 1938. *In English.*—An absorption band of Sm IV, $\lambda = 422\ m\mu$, not perceptible at low temperatures, was detected in borax solutions at 250° C. This band can be interpreted as a transition from the excited level of Sm IV $^6H_{7/2}$. The difference in the frequencies of the absorption bands of Sm IV, 422 and 403 $m\mu$, is in good agreement with the difference between the frequencies of the two most refrangible fluorescence bands. A strong broadening of the absorption bands of Sm and Nd with a rise in the temperature was detected. AUTHOR.

***4949. U.V. Absorption Spectra by Reflection. T. Guilmart and R. Freymann.** *Rev. d'Optique*, 19. *pp.* 199–202, *May*, 1938.—An arrangement is described, embodying a quartz spectrograph and hydrogen tube, for studying by reflection the absorption spectra of organic substances in the solid state. Difficulties were encountered owing to polarisation and the aberration of lenses, but when these were eliminated, good results were obtained. F. S.

4950. Visible and U.V. Absorption of Mineral Oxides and of their Hydroxides and Hydrates. A. Berton. *Comptes Rendus*, 207. *pp.* 625–627, *Oct.* 10, 1938.—Visible and u.v. absorption bands of solid mineral oxides are displaced towards higher frequencies by the presence of water of hydration or of constitution. Data are given for 17 oxides and their corresponding hydrated compounds. C. B. A.

4951. Absorption Spectra of Methyl Methacrylate and its Polymer. J. W. Goodeve. *Faraday Soc., Trans.* 34. *pp.* 1239–1244, *Oct.*, 1938.—On heating, liquid methyl methacrylate polymerises to a glass-clear solid. The former was examined as a pure liquid and in solution of hexane containing 0·00001 to 0·02 gm. mol./l.; in both cases identical spectra were obtained. Discs of the polymer, prepared by methods which are described, were examined. By using special cells, round which water at the desired temperature flowed, the changes in the spectrum during polymerisation have been followed. The characteristics of the extinction coefficient curves are discussed. W. R. A.

4952. Partial Analysis of Infra-Red Absorption Spectra of Organic Molecules in Dilute Solution. R. Wulf and L. S. Deming. *J. Chem. Phys.* 6. *pp.* 702–711, *Nov.*, 1938.—An attempt is made to resolve into component parts a number of relatively complex infra-red absorption coefficient curves for several OH-containing organic molecules in the region of the first overtone absorption of the OH group. Such analyses suggest certain relations between the structure of the molecule and its effect upon the character of the absorption of the absorbing group. AUTHORS.

4953. Negative Bands of N^{14}—N^{15}. R. W. Wood and G. H. Dieke. *J. Chem. Phys.* 6. *pp.* 734–739, *Nov.*, 1938.—The negative bands of nitrogen were photographed with a mixture which contained about 15% of N^{15}. The 0 → 0, 1 → 0 and 0 → 1 bands of the N^{14} — N^{15} molecule were analysed. Their position is within the limits of experimental errors where the elementary theory of the isotopic shifts predicts them. The bands do not show any intensity alternations and there are no perturbations at the places where the corresponding bands of ordinary nitrogen have them. AUTHORS.

4954. Pressure Effect in the 2590 Å Band of MgH. A. Guntsch. *Zeits. f. Physik,* 110. 9–10. *pp.* 549–552, 1938.—A pressure arc taking 0·8 A. at 3000 V was used as source, the pressure being 3 atm. Nearly twice as many lines were found in the 2590 Å band as had been observed previously in absorption. The bands only appear at higher pressure, and the rotation constant F gives them their characteristic appearance. F. S.

4955. Predissociation of Sulphur. M. Désirant and B. Rosen. *Physica,* 5. *pp.* 870–874, *Oct.,* 1938. *In French.*—Remarks on the discussion between W. Lochte-Holtgreven and E. Olsson [see Abstract 2898 (1938)] concerning the predissociation occurring in the band spectrum of S_2. It seems that the predissociation at $v' = 10$ is a natural one. AUTHORS.

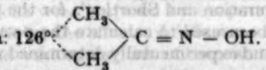
4956. Infra-Red Study of Acid Amide and Oxime Association. A. M. Buswell, W. H. Rodebush and M. F. Roy. *Am. Chem. Soc., J.* 60. *pp.* 2444–2449, *Oct.,* 1938.—Infra-red absorption has been studied for a number of acid amides and oximes. Association due to H-bonding is observed and in the case of monosubstituted amides association is accompanied by a considerable amount of enolisation. Attention is called to the striking similarity of the absorption due to association in the substituted amides and that due to the peptide group in gelatin. [See following Abstract.] AUTHORS.

4957. Infra-Red Study of Complex Formation Due to Hydrogen Bonding. A. M. Buswell, W. H. Rodebush and M. F. Roy. *Am. Chem. Soc., J.* 60. *pp.* 2528–2531, *Oct.,* 1938.—The tendency of HCl and $CHCl_3$ toward complex formation with ether and other substances through H-bonding has been investigated. These two compounds stand at opposite extremes in the scale of activity of the H. The rule of Venkateswaran has been verified for the shift of the fundamental frequency of the H. An absorption band which shifts to shorter wave-lengths upon bond formation has been observed in the case of $CHCl_3$ and this absorption has been ascribed tentatively to the second harmonic perpendicular vibration of the H. [See preceding Abstract.] AUTHORS.

4958. Absorption Spectra of Aromatic Hydrocarbons. T. Förster. *Zeits. f. phys. Chem.* 41. *Abt.B.* 4. *pp.* 287–306, 1938.—The theory of the origin of the u.v. absorption bands of benzene is extended to other aromatic hydrocarbons built up of phenyl rings. In a number of cases, qualitative discussion of the positions of the essential molecular energy states leads to correct conclusions. By a simplification of the usual quantum-mechanical treatment, the positions of the absorption bands of more complicated polyphenyl systems can be predicted with reasonable accuracy. C. B. A.

4959. Band Envelopes of Unsymmetrical Rotator Molecules. Part I. Calculation of Theoretical Envelopes. R. M. Badger and L. R. Zumwalt. *J. Chem. Phys.* 6. *pp.* 711–717, *Nov.,* 1938.—Since the majority of molecules of chemical interest are too heavy to permit resolution of the rotational structure of the infra-red bands, it is of interest to find what information can be derived from a study of the band envelopes. Considerations of the type which Gerhard and Dennison have made for symmetrical molecules have been extended to the unsymmetrical rotator. By the use of an approximation method the envelopes of the three elementary types of band have been calculated for nine different sets of molecular parameters. AUTHORS.

4960. Calculation of Frequencies of Symmetrical Modes of Vibration for Molecules with Various Types of Symmetry. H. J. Bernstein. *J. Chem. Phys.* 6. *pp.* 718–722, *Nov.*, 1938.—The secular equations for the frequencies of the symmetrical modes of vibration for molecules with various types of symmetry have been developed. The types of symmetry considered include a centre of symmetry, and twofold, threefold, and fourfold axes of symmetry. Application to the problem of the configuration of oximes indicates that acetoxime has the following structural formula:



$$126^\circ \begin{matrix} CH_3 \\ CH_3 \end{matrix} \!\!>\! C = N - OH.$$

AUTHOR.

4961. Molecular Potential Curves from Spectroscopic Data. A. S. Coolidge, H. M. James and E. L. Vernon. *Phys. Rev.* 54. *pp.* 726–738, *Nov.* 1, 1938.—The problem of determining accurately a molecular potential curve from spectroscopic data on the system is analysed, and the difficulties are discussed in detail. In general the principal difficulty arises from the importance in the energy expression of terms in high powers in the quantum numbers; to deal with this, recourse may be taken to a method employing graphical integration. Formulæ based on the first order of the W.B.K. approximation are usually but not always adequate. One can obtain markedly better results in determining potential curves by dealing directly with the energy levels which it is desired to reproduce, rather than by the usual method of making the curve reproduce a limited number of spectroscopic constants. A method of successive approximations has proved to be particularly effective in giving accurate results. Formulæ are given for the convenient manipulation of potential curves of the types suggested by Morse, Pöschl and Teller, Hylleraas, Dunham, and also a generalisation of the Morse curve. This last curve has proved to be most satisfactory, combining great flexibility with relative ease of manipulation; explicit solutions for vibrational wave functions are not obtainable for it, however. The discussion is illustrated by extensive computations on the lowest ${}^3\Sigma_g$ state of H_2, for which a potential curve very accurate in the range of nuclear separations $1\cdot 3 < r < 2\cdot 9\ a_H$ is obtained. AUTHORS.

4962. Systematics of Band-Spectral Constants. Part IV. C. H. D. Clark and J. L. Stoves. *Faraday Soc., Trans.* 34. *pp.* 1324–1328, *Nov.*, 1938.—The results of calculation of equilibrium internuclear distance from vibration frequency for di-atoms have been compared with experimental numbers. The paper is chiefly concerned with a comparison between the method devised by Huggins, based upon a modified Morse potential energy function, and the formula we have proposed. It is pointed out that in both cases allowances have been made in assigning constants not only for the periods and groups involved, but also for the nature of the atoms concerned, in such a way that the question of electron configuration essentially enters in. The authors' formula appears to be the most generally suitable proposal so far put forward for calculating internuclear distance, when both reliability of the results and speed with which approximations can be made are considered. This work shows that the correct interrelation of the two magnitudes concerned (ω_e and r_e) involves constants which are very sensitive to structural changes. [For Parts I–III see Abstract 5356 (1937).] AUTHORS.

4963. Zeeman Effect in Spectrum of Neon. J. B. Green and J. A. Peoples, Jr. *Phys. Rev.* 54. *pp.* 602–605, *Oct.* 15, 1938.—Measurements on about 250 lines of the spectrum of Ne in fields of 27,000–32,000 gauss have now been completed. The Ne discharge was excited by means of an electrodeless h.f. discharge (about 40 megacycles) at right angles to the magnetic field and to the line of sight. The lines, extending from about 3100–9000 Å include transitions involving all of the levels of the $2p^5 4p$, the $2p^5 3d$, $2p^5 4d$ configurations, and parts of others. A large number of "forbidden" lines also appear. Sampson's calculations for the parameters of the $2p^5 3d$ configuration and Shortley's for the parameters of the $2p^5 4d$ configuration have been used to calculate the g-values. The agreement between theoretical and experimentally determined values is excellent. AUTHORS.

4964. Raman Spectra of Molybdic Acid and Molybdates in Aqueous Solution. M. Théodoresco. *Comptes Rendus*, 206. *pp.* 753–754, *March* 7, *and* 207. *pp.* 531–532, *Sept.* 26, 1938.—The Raman spectra of molybdic acid, (*i*), neutral sodium molybdate, (*ii*), ammonium molybdate, (*iii*), and sodium paramolybdate, (*iv*), have been examined in aqueous solution. Three frequencies 313, 839 and 987 cm^{-1}., the latter two forming a doublet, are shown by (*ii*): This spectrum, which is similar to that of the SO_4'' ion, is due to the MoO_4'' ion. The spectrum of (*iii*) shows six displacements, of which two (938 and 892 cm^{-1}.) also form a doublet analogous to that observed in (*ii*), and is due to the Mo_7O_{24}'' ion. The spectrum of (*iv*) is identical with (*iii*), and that of (*i*) is characterised by a triplet 950, 901 and 853 cm^{-1}., of which 853 cm^{-1}. has no corresponding displacement in the salts. W. R. A.

***4965. G.E.C. Recording Spectrophotometer. J. L. Michaelson.** *J.O.S.A.* 28. *pp.* 365–371, *Oct.*, 1938.—Some of the problems, and their solutions, encountered in the production of a commercial spectrophotometer are discussed. In its final form the instrument comprises two sections, (*a*) the photometer and (*b*) the monochromator and recorder. Amongst other advantages this makes the two sections separately available for other purposes. The various component mechanisms are described at length. [See following Abstract.] A. H.

***4966. Calibration and Operation of the G.E.C. Recording Spectrophotometer. K. S. Gibson and H. J. Keegan.** *J.O.S.A.* 28. *pp.* 372–385, *Oct.*, 1938.—The spectrophotometer [see preceding Abstract] installed at the National Bureau of Standards has certain features not found on the commercial form. The wave-length scale is longer, finer slits are used, cams are available for plotting on a log or log log scale, higher voltages are applied to the valves, and a variable capacity is included in the output impedance of the amplifier. The effect of these changes on the working of the instrument is described, and the various errors encountered are discussed. [See preceding Abstract.] A. H.

See also Abstracts 4843, 4850, 4914, 4972, 4976, 5049.

VISION.

***4967. Vision through Optical Instruments. T. Smith.** *Phys. Soc., Proc.* 50. *pp.* 863–887, *Nov.* 1, 1938. *Presidential Address.*—No new results are presented but a number of topics of interest to opticians and teachers are discussed. These include the teaching of geometrical optics, the curvature method and vision through instruments. The extension of the elementary theory to systems not having symmetry about an axis is also discussed, as is its application to simple instruments. A. H.

X-RAYS.

4968. Azimuthal Intensity Distribution of X-Rays. K. Böhm. *Ann. d. Physik*, 33. 4. *pp.* 315–334, *Oct.*, 1938.—In order to verify some earlier work by Kulenkampff (*ibid.* 87. 4. *p.* 597, 1928) on the distribution of intensity in azimuth of X-rays scattered from Al-foil $0\cdot6\mu$ thick, the experiments have been repeated with Mg-foil of thickness less than $0\cdot1\mu$. The foils were prepared by evaporation on to celluloid films. By the use of thin foils, the effects of diffusion and the loss of velocity are minimised. In the various regions of measurement, investigations were carried out on (1) the dependence of the azimuthal intensity distribution on the wave-length at constant tube potential (for 20, 31 and 40 kV); (2) the dependence on the potential for the existing limiting wave-lengths, and (3) the dependence on the potential for a constant wave-length (0·65 Å). The distribution curves obtained show a marked asymmetry, in agreement with the earlier results. The agreement of the distribution curves with theory, for a wave-length region near the limiting wave-length, is good as far as the positions of the maxima and the shapes of the curves are concerned. G. O. B.

4969. X-Ray Scattering at Small Angles. K. Alexopoulos and S. Peristerakis. *Phys. Zeits.* 39. *pp.* 688–690, *Oct.* 1, 1938.—The primary assumptions made in calculating the theoretical angular distribution of scattered X-rays are that the conduction electrons are completely free and that they have no temperature gradient. These assumptions are not fulfilled in reality, so that a variation from the theoretical curve is to be expected in the experimental results at small angles. Such a result is obtained with Be in this paper in the angular range for which $(\sin\theta/2)/\lambda$ lies between 0·013 and 0·054. The difference between the experimental curve and the theoretical curve is in the expected direction. Some of the variation can be explained by temperature effect while some is possibly due to the influence of the crystal lattice. G. O. B.

4970. Estimation of X-Rays Incoherently Scattered by Gases. K. Hoffmann. *Phys. Zeits.* 39. *pp.* 695–706, *Oct.* 15, 1938.—Up to the present the magnitude of the modified X-rays scattered by matter has had to be calculated theoretically. An account is here given of experimental measurements. The modified and unmodified radiation were separated by means of suitable filters, whose properties were investigated. Absolute measurements were made of both the modified and unmodified intensities for CO_2, using $WL\alpha_1$ and $WL\beta_2$ radiation. The results obtained show that the total intensity is throughout greater than is to be expected from the original theory. For example, with Sin $\delta/_2/\lambda = 0\cdot60$ the value obtained was 35 Thomson units, while the theoretical value is only 27 units. The result of the measurements made with monochromatic radiation, that the ratio of the unmodified to the modified intensity is greater than is to be expected theoretically, is thus substantially supported. The possibility cannot, however, be excluded of some systematic error affecting mainly one of the components. The measurements with CO_2 show that it is possible to separate the two parts of the scattered radiation and to measure them with sufficient accuracy. This result is important from an application point of view. It also appears that for CO_2 the outer electrons are not satisfactorily represented by present theory. Whether this is concerned with the effect of the bound electrons or with a poor approximation to the charge distribution may be decided by experiments on the rare gases, which call for improved technique. The method of determining the intensities of both parts of the scattered radiation is, however, an important contribution to the study of the finer problems of electron distribution, for which measurements of the total intensity alone were quite insufficient.

A. W.

4971. Scattering and Photoelectric Absorption of H.V. X-Rays in Nitrogen. H. C. Trueblood and D. H. Loughridge. *Phys. Rev.* 54. *pp.* 545–554, *Oct.* 15, 1938.—A study of the expansion chamber tracks of 810 kV X-radiation passing through N_2 shows that the angular distribution of total electrons emitted is in good agreement with the Klein-Nishina formula when allowance is made for the presence of photoelectrons. The latter are distinguished from recoils by the criterion of the maximum Compton energy. Electrons having energies greater than the Compton energy for the corresponding angle of emission were classified as photoelectrons while those having smaller energies were either photo- or recoil electrons. The ratio of recoils to photoelectrons is of the order of 100 in contrast to the theoretical value of about 5000. The angle of bipartition for photoelectrons is about 48° for 360 ekV and about 20° for 650 ekV photoelectrons. AUTHORS.

4972. Intervals of X-Ray Spin-Doublets. G. Araki and S. Noma. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 746–754, *Sept.*, 1938.—The intervals of the X-ray spin-doublets are calculated for the *L*, *M*, and *N* terms of Cl, K, Ca, Cu, Rb and Cs atoms, on the basis of the Breit Hamiltonian. The eigenfunctions used in the computations involve the Hartree or the Hartree-Fock radial functions. The agreement between the calculated and the observed values is satisfactory in general. [See also Abstract 4053 (1937).] AUTHORS.

4973. Effects of Radiation on Oil. W. Stenstrom and I. Vigness. *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 427–433, *Sept.*, 1938.—Chemical reaction is produced by radiation—commonly oxidation and, less frequently, reduction—different types of radiation causing different effects. X-rays produce ionisation but this is relatively very small and difficult to measure. In order to measure these minute changes the authors utilise oil drops on water, the spread of which is proportional to the number of acid molecules present so that, if X-rays cause oxidation of the oil, the size of the drop increases subject to other factors such as impurities of the water which modify the spread. This effect has been studied with a trade oil" Bacol." The method has been applied in two ways, viz. irradiation of the oil in test tubes or when spread in drops on water. The effect has been demonstrated for X-rays, β-rays and short wave u.v. rays, detailed data and curves being given in respect to the experimental work. The effect of temperature has been studied. The effects increase with dose administered but no difference has been observed with X-rays produced at 100 and 200 kV. Twice the dose was required to produce changes in oil spread on water, as compared with oil irradiated in test tubes. With heavy X-ray doses change occurs in the absorption spectrum, indicating oxidation and unsaturation of the oil. B. J. L.

4974. Influence of Elastic Anisotropy on X-Ray Measurement of Strain. R. Glocker. *Zeits. f. techn. Physik*, 19. 10. *pp.* 289–293, 1938.—The elastic anisotropy of polycrystalline iron, as measured by X-ray methods, is considered in relation to the angle of incidence of the X-ray beam. The values obtained by X-rays are compared with those obtained by calculation and it is found that the assumption of the free and independent extension of the constituent single crystallites is not justified. J. T.

***4975. Concave-Grating Vacuum Spectrograph for Wave-Lengths 15 to 1000A. F. C. Chalklin, S. S. Watts and S. P. Hillson.** *Phys. Soc., Proc.* 50. *pp.* 926–933, *Nov.* 1, 1938.—A vacuum spectrograph for work with soft X-rays is described. It employs a 1-m. concave grating in the grazing-incidence position. The instrument is designed to permit the optical system to be adjusted before it is placed in the vacuum chamber, so that trial-and-error focusing may be minimised. It makes provision for varying the grazing angle without any necessity for readjustment. Tests of the instrument are described and discussed. AUTHORS.

See also Abstract 5050 and

3479B. X-Ray Tube for Analysis of Crystal Structure. J. E. de Graaf and W. J. Oosterkamp.

HEAT.

CALORIMETRY.

4976. Nuclear Spin and Symmetry Effects in the Heat Capacity of Ethane Gas. E. B. Wilson, Jr. *J. Chem. Phys.* 6. *pp.* 740–745, *Nov.*, 1938.—The heat capacity of ethane gas has been calculated for a number of values of the internal potential barrier from zero to high barriers. Detailed account of the presence of noncombining species and of the exact nuclear spin statistical weights was taken. It was found that down to temperatures at least as low as 90°K. these phenomena are entirely unimportant and that the partition function calculated in the usual way is correct. It is concluded that the observed experimental data are best explained by the assumption of a high restricting potential. Tables of statistical weights for the rotational levels of C_2H_6 and C_2D_6 are given. [See Abstract 2576 (1935).] AUTHOR.

4977. Specific Heat of Water (H_2O) Between 0° and 100° C. W. A. Roth. *Zeits. f. phys. Chem.* 183. *Abt.A.* 1. *pp.* 38–42, 1938.—The calculations of Fiock and Jessel are critically considered. After suitable weighting the author obtains the most probable formula for the true specific heat of light water between 0° and 40° C. as $C = 1\cdot0066 - 0\cdot0005696\theta + 0\cdot000008742\theta^2$. $C_{0°C} = C_{100°C}$. and the minimum of 0·9974 appears at about 35°C. D. R. H.

4978. Heat Capacity of Bi. H. L. Bronson and L. E. MacHattie. *Canad. J. of Research*, 16. *Sect. A. pp.* 177–182, *Sept.* 1938.—The mean heat capacity of Bi over 10° intervals has been determined from — 80° to 120° C. by means of adiabatic electrical heating in a copper jacket. The maximum deviation of any individual point from a smooth curve is 0·1%, and the error in the absolute values obtained is considered to be not more than 0·1%. No discontinuities or irregularities were found; in fact, the experimental results are represented to within the limits of experimental error by the linear equation : $C_p = 0{\cdot}1238_5 + 4{\cdot}45 \times 10^{-5}t$, where t is the Centigrade temperature, and the units are joules/gm./°C. The equation : $C_p = (D/209{\cdot}0)\ (119/T) + 3{\cdot}99_7 \times 10^{-7}T^{1{\cdot}703}$ was found to fit the mean experimental curve as closely as the graph could be read (0·02%). T is the absolute temperature and $D(119/T)$ the Debye function for C_v per mole. C_p is given in joules/gm./°C. A calculation of C_p from non-thermal data gives values about 3% low. AUTHORS.

4979. Specific Heats and Heat of Fusion of $TeCl_4$. K. J. Frederick and J. H. Hildebrand. *Am. Chem. Soc., J.* 60. *pp.* 2522–2523, *Oct.*, 1938.—Employing the method of mixtures, the heat of fusion of $TeCl_4$ at the melting point was found to be 4510 ± 30 cal./mol., the molal heat capacity of solid $TeCl_4$ in the interval 25–224·1°, 33·1 ± 0·3 cal./mol., and the molal heat capacity of liquid $TeCl_4$ in the interval 224·1–265°, 55·0 ± 0·5 cal./mol. AUTHORS.

4980. Low-Temperature Heat Capacity Measurements on BF_3, CF_4 and SF_6. A. Eucken and E. Schröder. *Zeits. f. phys. Chem.* 41. *Abt.B.* 4. *pp.* 307–319, 1938.—The molal heats of BF_3, CF_4 and SF_6 (at intervals of 5° from 12° K. up to temperatures above the melting points) together with the heats of fusion and transition have been determined. An adiabatic vacuum calorimeter was employed. The transition in CF_4 at 76·23° K. is sharp and is probably due to a change in the rotational state of the molecules. In BF_3 the transition occurred at 142·15° K. which is just below the melting-point 144·46° K. The transition in SF_6 at 94·3° K. is peculiar in that the transition is sharp on cooling but not on heating. From vapour-pressure data obtained by others and the calorimetric data, the authors have calculated the entropies (at 298·2° K. and 1 atm. pressure) of the three fluorides. The statistically determined entropies are shown to be in close agreement with those values. S. W.

4981. Latent Heat of Fusion of Aluminium. J. H. Awbery. *Phil. Mag.* 26. *pp.* 776–784, *Nov.*, 1938. *Supplement.*—The extremes among the published values for the latent heat of fusion of Al differ by about 50%, and the results fall into two groups, one with a mean about 92 cal./gm. and one about 77 cal./gm. A method has been used in which the electrical energy required to melt a known mass is measured, and it gives a result of 91 cal./gm. The various low values in the literature are attributed to impurities or to inherent inaccuracies in method. It is suggested that the most probable value is 92·4 ± 0·5 cal./gm. AUTHOR.

See also Abstract 4994.

CONDUCTION.

See Abstract 4994.

DILATATION.

4982. Expansion of Crystals in Relation to their Structure. H. D. Megaw. *Zeits. f. Krist.* 100. 1. *pp.* 58–76, 1938. *In English.*—Expressions are derived for the coefficient of thermal expansion of non-metallic crystals in terms of their structure and interatomic forces. For homodesmic crystals (atoms linked to their neighbours by forces of the same kind throughout the whole structure) an empirical rule is put forward that the mean linear expansion coefficient is approximately proportional to the electrostatic share. Those crystals which depart from this rule are discussed individually and anisotropy of expansion is also discussed. J. I.

4983. Dilatometric Anomalies in Cu-Al Alloys. A. Boutillier. *Comptes Rendus*, 207. *pp*. 498–500, *Sept*. 19, 1938.—The author has previously pointed out that alloys with 7–16 parts Cu per 100 Al have certain dilatometric anomalies which are due neither to changes of density nor to plasticity changes [see Abstract 5195 (1936)]. From tests made with a Chevenard dilatometer on alloys of about 12 parts Cu per 100 Al the author concludes that these anomalies classified previously as unexplained are of a special type dependent upon the rate of cooling adopted in cooling down the specimen from above 580°. The dilatometric aspect of these anomalies is irregular, for both the sign and order of the anomalies vary considerably, rapid cooling for example producing an increase in length whereas slow cooling produces a contraction. S. W.

FUSION AND SOLIDIFICATION.

4984. Intensity of Orbital Interaction in Transition Elements. R. Forrer. *J. de Physique et le Radium*, 9. *pp*. 387–392, *Sept*., 1938.—Modifications in the author's theory [see Abstract 4595 (1937)] necessary to explain the very high melting points of some transition elements (*e.g*., Ru, Ta, W, etc.), and the allotropic modifications of Ti and Zr, are described. The approximate identity of the melting point of He and the temperature at which supraconductivity occurs is stressed, and it is suggested that both are connected with the lattice of *s* electrons. C. A. S.

4985. Cryoscopy in Saline Solutions. E. Cornec and H. Muller. *Comptes Rendus*, 207. *pp*. 578–580, *Oct*. 3, 1938.—The crysoscopic curves of molecular lowering *versus* concentration, Δ/c, for aqueous solutions usually become curved as concentration decreases, so that the results of extrapolation to zero concentration become indefinite. If instead of H_2O a solution of *e.g*. KNO_3 of constant concentration is used the curves become straight lines, but Δ_0 for $c = 0$ for various electrolytes bears no simple relation to Δ_0 for a non-electrolyte, *e.g*. urea. If the solution used, however, be of that concentration in KNO_3 which with the added electrolyte is eutectic, the molecular lowering for c_0 of the added electrolyte does bear a simple ratio, which depends on the number of foreign ions (*i.e*., in this case other than K^+ or NO_3^-) added. Several actual results are given in illustration. [See Abstract 3816 (1932).] C. A. S.

See also Abstract 5000.

TEMPERATURE.

See Abstract 4980.

THERMOCHEMISTRY.

4986. Heat Contents of Salts of Alkali Metals in Extremely Dilute Aqueous Solutions. T. F. Young and P. Seligmann. *Am. Chem. Soc., J*. 60. *pp*. 2379–2383, *Oct*., 1938.—The method applied by Young and Groenier [see Abstract 1756 (1936)] to the heats of dilution of aqueous NaCl solutions has been extended to all other salts of the alkali metals for which sufficient data are available for the application of the least square technique. The average value of the limiting derivative, S^0, for eleven salts of the 1–1 valence type at 25° and $S^0/3^{3/2}$ for five salts of the 1–2 valence type is about 30% larger than the average of the older estimates based upon an assumed linear relation between the apparent molal heat content and the square root of the concentration. The new average agrees with the theoretical value calculated from Wyman's dielectric constant measurements and the Debye-Hückel limiting law. Since the calculated values of S^0 appear to confirm the Debye-Hückel limiting law and Wyman's measurements a second set of derivative equations have been derived in which S^0 was fixed at the theoretical value. AUTHORS.

4987. Heats of Combustion of Anthracite Cokes and of Artificial and Natural Graphites. P. H. Dewey and D. R. Harper. *Bureau of Standards, J. of Research*, 21. *pp.* 457–474, *Oct.*, 1938.—There have been determined the heats of combustion of 30 samples of anthracite coke of known different temperatures of preparation (900° to 1300° C.), H contents (0·08 to 0·78%), and adsorptive capacities (0·13 to 37·5 cm^3. of gaseous CO_2 per gm. of solid carbon), in order to study the effect of these properties on the energy content of the material. Data were also obtained on the heats of combustion of two samples of pure ash-free artificial graphite and four different samples of natural graphite. The heats evolved, expressed in international kilojoules, for the combustion of 1 mole of solid carbon to form CO_2, at 25·0° C. and a pressure of 1 atm., without the production of external work, are as follows: Artificial graphite No. 0, **393·39 ± 0·17**; artificial graphite No. 1, **393·25 ± 0·15**; Ticonderoga natural graphite, **393·32 ± 0·11**; Buckingham natural graphite, **393·35 ± 0·13**; Baffin Island natural graphite, **393·37 ± 0·26**; and H-free anthracite coke, **403·03 ± 0·29** (obtained by linear extrapolation to zero H content of the data on the H-containing cokes). AUTHORS.

4988. Heats of Combustion of Diamond and of Graphite. R. S. Jessup. *Bureau of Standards, J. of Research*, 21. *pp.* 475–490, *Oct.*, 1938. —Measurements were made of the heats of combustion of one artificial graphite, two natural graphites, and two samples of diamond. The bomb calorimeter used was calibrated electrically and by means of benzoic acid. The amount of reaction in each combustion experiment was determined from the mass of CO_2 formed. This method of determining the amount of reaction automatically eliminates the effect of unburned C and of some impurities. It was found, however, that results for different samples did not agree unless the samples were purified. Two methods of purification were used: (*a*) Heating *in vacuo* to 1800° C., and (*b*) treatment with HCl and HF and subsequent heating *in vacuo* to 200° C. to remove traces of the acids. Both methods yielded graphite containing only small amounts of impurities. The mean value obtained for the heat of combustion $(-\Delta H)$ of the purified graphites in O_2 at 25° C. and a constant pressure of 1 atm. to form gaseous CO_2 at the same temperature and pressure was **393·396** international kj./mol. (**44·010** gm. of CO_2). The maximum deviation of the mean value for any one of the purified samples from this value was 0·021%. The two samples of diamond, purified by treatment with aqueous HCl and HF and subsequently heated *in vacuo* to about 570° C., had average particle sizes of **2·5** μ and **39·5** μ respectively, and yielded the following respective mean values for the heat of combustion $(-\Delta H)$ at 25° C. and 1 atm., in O_2 to form gaseous CO_2: **395·771** and **395·287** international kj./mol. The difference between the two values, which is several times the estimated uncertainty of the measurements, is in proper direction to be accounted for on the basis of particle size, but the first sample appears to be not fine enough to account quantitatively for the difference. AUTHOR.

4989. Heat and Free Energy of Formation of CO_2, and of the Transition between Graphite and Diamond. F. D. Rossini and R. S. Jessup. *Bureau of Standards, J. of Research,* 21. *pp.* 491–513, *Oct.,* 1938.—There are reviewed the existing data on the entropies of O_2, CO_2, graphite, and diamond, and those on the heats of combustion of natural and artificial graphite and of diamond, including the results recently obtained in a joint investigation by the National Bureau of Standards and the Coal Research Laboratory of the Carnegie Institute of Technology. The new thermochemical data are combined with values of the entropies to obtain values for the heat and free energy of formation of CO_2, and for the transition between graphite and diamond. For C (*c*, graphite) + O_2 (*g*) = CO_2 (*g*), at 25° C., per mole, $\Delta H^\circ = -393{,}355 \pm 46$ NBS international joules, or $-94{,}030 \pm 11$ cal., and $\Delta F^\circ = -394{,}228 \pm 58$ NBS international joules, or $-94{,}239 \pm 14$ cal. For C (*c*, graphite) = C (*c*, diamond), at 25° C. and 1 atm., $\Delta H = 1899 \pm 124$ joules, or 454 ± 30 cal., and $\Delta F = 2872 \pm 129$ joules, or 686 ± 31 cal. For this transition, the following equation is derived, with some approximations, for the range T = 273° to 1400° K., and P = 0 to 20,000 atm.: $\Delta F = 541{\cdot}82 + 6700/T + 1{\cdot}17662\ T \log T - 2{\cdot}43723\ T - 0{\cdot}000221\ T^2 - [0{\cdot}045660 + 0{\cdot}91236 \times 10^{-3}\ T - 0{\cdot}7830 \times 10^{-10} T^2 - 0{\cdot}3623 \times 10^{-12} T^3]\ P + 0{\cdot}19 \times 10^{-6} P^2$ cal./mol. (In all of the foregoing values, conversion from the NBS international joule to the conventional calorie is made with the factor 1/4·1833.) AUTHORS.

4990. Fundamental Oscillations in Burning Gas Mixtures. G. Guderley. *Zeits. f. angew. Math. u. Mechanik,* 18. *pp.* 285–308, *Oct.,* 1938.—The oscillations produced when a gas mixture burns in a closed cylindrical vessel are studied mathematically with respect to origin, growth and decay, and particularly as regards the influence of pressure. The case of the combustion velocity when independent of pressure is also investigated. The various differential equations are derived, and the influence of the oscillations on entropy distribution discussed. It is shown from two extreme examples that the internal thermal exchange need not be considered for the final result; but that the influence of pressure on combustion velocity is of supreme importance. A procedure is given for determining the form of the fundamental oscillations in the heterogeneous gas distribution. H. H. Ho.

4991. Special Solutions for the Motion of Powder Gas. R. H. Kent. *J. of Applied Physics,* 9. *p.* 734, *Nov.,* 1938.—A correction of a statement made in the original. [See Abstract 4792 (1936).]

4992. Explosive Processes. W. Jost and L. v. Müffling. *Zeits. f. phys. Chem.* 183. *Abt. A.* 1. *pp.* 43–54, 1938.—The customary formal treatment of explosive processes with its convenient mathematical formulation of an infinite velocity of reaction in series explosions is briefly discussed and shown to lead to certain inconsistencies. Semenoff's formal expression for the velocity of reactions [see Abstract 2226 (1928)] is considered to be invalid in complicated cases, more especially as the expression permits an infinite value of the velocity. A modification of the expression for the velocity, which does not permit an infinite value is suggested. The explosion of Knall-gas is discussed in considerable detail from the points of view of these two equations, account being taken both of processes interrupting the series of reactions and of side reactions. J. S. G. T.

See also Abstract

3483B. Dust Explosions. W. Gliwitzky.

THERMODYNAMICS.

4993. Phase Integrals and Thermodynamics. K. Husimi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 757–769, *Sept.*, 1938.—The physical bearing of the Bernstein-Widder theorem concerning the Laplace integral is discussed in connection with the statistical expression of the Planck characteristic function. The result is a partial perfection of the Boltzmann-Gibbs procedure of constructing the fundamental formalism of statistical mechanics. The result of the foregoing investigation is that there exists only a very weak connection between thermodynamics and statistics; the logarithmic convexity, which the author opines to exhaust all the thermodynamic requirements, follows from the complete monotony but not inversely. The so-called thermodynamic statistics of Einstein and others appear only to be valid when no higher terms than the quadratic are retained in the expansion of S. H. H. Ho.

4994. Molecular Theory of Gases. Part II. M. Trautz. *Die Physik*, 6. 4. *pp.* 163–180, 1938.—The first part of this work appeared some time ago [see Abstract 4983 (1933)]. This paper is a review of the literature dealing with statistical models, equilibrium conditions, specific heats and chemical constants, transport processes, viscosity, thermal conduction, diffusion, temperature drop etc. A large number of references is included. E. H. D.

4995. Thermal Hysteresis in HBr Transformations. A. Eucken and W. Güttner. *Göttingen Nachrichten, Fachgruppe II.* 2. 14. *pp.* 167–180, 1937.—In a previous paper [see Abstract 298 (1937)] the transformation of CH_4 has been investigated and here similar experiments on HBr at 89°Abs. are described. The experimental details are given in full and include two methods, one using ultrasonics. The results are given graphically and their theoretical significance is discussed at length. E. H. D.

4996. Persistence of Liquid State of Aggregation above the Critical Temperature. R. L. McIntosh and O. Maass. *Canad. J. of Research*, 16. *Sect. B. pp.* 289–302, *Sept.* 1938.—The data obtained by Maass and Geddes [see Abstract 4609 (1937)] on the properties of ethylene in the critical-temperature–critical-pressure region have been substantiated although it was shown that a small correction had to be applied to their absolute values of density. It was shown that at the critical density of ethylene the difference between the densities of the medium below and above the point at which the meniscus disappeared was a maximum. The conclusion of Mayer and Harrison [see Abstract 979 (1938)] that, at a temperature just above that at which the meniscus disappeared, the pressure of the system remains constant over a considerable variation of mass per volume, has been corroborated. The effect of the presence of small measured quantities of air has been examined. The phenomena observed are explained on the basis that there is a difference between the gaseous and liquid states of aggregation with a structure assigned to the latter. AUTHORS.

4997. Low-Temperature Properties of Gaseous Helium. H. S. W. Massey and R. A. Buckingham. *Roy. Soc., Proc.* 168A. *pp.* 378–389, *Nov.* 7, 1938.—The viscosity and second virial coefficients of He are calculated in the temperature range 0–26°K. using exact quantum formulation and the interatomic interaction given by Slater. It is found that there is very good agreement with the observed viscosity down to 15°K., but below this temperature the calculated values are too small.

The correct form for the variation of the virial coefficient with temperature is obtained, but the calculated behaviour is in error in predicting too low temperatures for the position of the maxima, etc. (The calculated Boyle point is 21° compared with the observed 23°.) It is shown that the discrepancies may be greatly reduced in both cases by small modification of the Slater field involving reduction of the van der Waals force at large distances and inclusion of dipole-quadripole interaction. No difference between the theoretical results obtained by assuming different statistics is sufficiently definite to be distinguished from small errors in the assumed interaction, in the temperature range from 1°K. upward. AUTHORS.

*4998. **Compressibilities of H_2 and of $H_2 + N_2$ Mixtures. R. Wiebe and V. L. Gaddy.** *Am. Chem. Soc., J.* 60. *pp.* 2300–2303, *Oct.*, 1938.—Previous work since 1930 on the compressibilities of H_2, N_2 and their mixtures has been summarised. A modified Bartlett compressibility apparatus is described. The compressibilities of H_2 and four H_2-N_2 mixtures have been measured at 0, 25, 50, 100, 200 and 300° and to 1000 atm. AUTHORS.

4999. **Formation of Surfaces in Liquid-Liquid Mixtures. W. W. Lepeschkin.** *Kolloid Zeits.* 85. *pp.* 52–56, *Oct.*, 1938.—The theory of the structure of liquid "precipitates" is considered. In the separation of liquid phases of aqueous molecular solutions, *e.g.*, in the system $(NH_4)_2SO_4$—H_2O—EtOH, the interfacial layer of one of the phases (usually the upper one) is formed from molecules of the liquid dissolved in the H_2O, which having come sufficiently close together, are held by their mutual molecular attraction. In the above-mentioned system the boundary layer of the upper phase is formed of EtOH molecules. The phenomenon in the case of colloidal solutions is also examined. Here the boundary layer of one of the phases (usually the lower one) is formed of micelles or macro-molecules of the colloid held together by molecular attraction. These micelles contain a good deal of H_2O, thus making the phase liquid. It may be described as a micellar liquid in which H_2O is molecularly dissolved. A. J. M.

5000. **Ordering and Transformations in Condensed Phases. F. C. Frank and K. Wirtz.** *Naturwiss.* 26. *pp.* 688–694, *Oct.* 21, *and pp.* 697–705, *Oct.* 28, 1938.—A review dealing with the thermodynamic and molecular treatment of transformations in condensed phases. The thermodynamic classification of such transformations is given, reference being made to the transformation of the second kind with He, and the rotational transformations of CH_4 and CD_4. The transformations of liquid crystals, superstructural transformations, and the phenomenon of fusion are considered. [*See also remarks by* **M. v. Laue.** *Ibid. p.* 757, *Nov.* 18, 1938.] A. J. M.

See also Abstracts 4821, 4980, 5004, 5009.

VAPORISATION AND CONDENSATION.

5001. **Boiling Point and Chemical Constitution. Part II. Calculation of Degree of Association at the Boiling Point. V. C. E. Burnop.** *Chem. Soc., J. pp.* 1614–1618, *Oct.*, 1938.—In Part I [see Abstract 3323 (1938)] it was shown that the function $(b) = M \log T + 8{\cdot}0\sqrt{M}$, is additive for unassociated compounds, and contributions to (b) of various atoms and structures were evaluated. This function is now used to calculate the boiling point, T′, which an associated compound should have in the unassociated state ; and, following Walker's generalisation that the molecular weights of related compounds vary approximately as the squares of their absolute boiling points, $(T/T')^2$ is regarded as giving the degree of association. These values are recorded for several classes of compound. AUTHOR.

***5002. Continuous High-Vacuum Still and Boiling-Point Apparatus, and the Systematic Distillation of a Dewaxed Lubricant Fraction of Petroleum. R. T. Leslie and W. W. Heuer.** *Bureau of Standards, J. of Research*, 21. *pp.* 515–533, *Oct.*, 1938.—A sample of lubricant stock having about the properties of light automobile lubricating oil was obtained from a refinery supplied with crude oil from the Oklahoma City field. 240 gallons were distilled through a semi-commercial vacuum still. A continuous high-vacuum laboratory still and an apparatus for determining boiling points were constructed and the material was distilled systematically three times with their aid. After the third distillation, there remained 762 kg. of material which distilled between 135° and 270° C. at 1 mm. Hg. The material tended to concentrate in four boiling ranges. The results of distillation of lubricant and naphtha fractions from a Ponca City petroleum are compared at the same stages. AUTHORS.

5003. Production of Condensation Nuclei in the Presence of Electrical Charges. G. Tohmfor and M. Volmer. *Ann. d. Physik*, 33. 2. *pp.* 109–131, *Sept.*, 1938.—A theory of the production of condensation nuclei in the presence of electrical charges is elaborated, which goes beyond the well-known Thomson theory in that it accounts also for the observed variation in the critical expansion ratio with the ion density and the strength of the electric field. The calculation is based on considerations of local fluctuations in density of the water vapour which may cause both agglomeration of water molecules to form a condensation nucleus and also sufficient supersaturation to cause that nucleus to grow to a visible drop. With further assumptions concerning the polarisation of water molecules, fair agreement is obtained with experimental data. The value deduced for the dielectric constant of the condensation nuclei is much less than that of water in bulk. The theory is applied to the production of condensation nuclei during electrolysis at high current densities. F. C. C.

5004. Equilibria in Two-Phase, Gas-Liquid Hydrocarbon Systems. Part II. E. H. Boomer, C. A. Johnson and A. G. A. Piercey. Part III. E. H. Boomer and C. A. Johnson. *Canad. J. of Research*, 16. *Sect.B. pp.* 319–335, *Sept.*, 1938.—In Part II the densities and compositions of both phases in the *n*-pentane-methane solubility equilibrium have been determined at 25°, 55°, and 85° C. at total pressures from 35 to 190 atm. The critical pressures of complete miscibility were found. The properties of the system are discussed. Similar measurements at 25° C. and at pressures from 35 to 135 atm. were made on a system composed of a mixture of *n*-pentane and isopentane with methane. In Part III the densities and compositions of both phases in the *n*-hexane-methane solubility equilibrium have been determined at 25°, 55°, and 85° C., at total pressures from 35 to 230 atm. The critical pressures of complete miscibility were found. The properties of the system are discussed. Similar measurements were made on a system consisting of a liquid mixture, principally isomeric hexanes, and methane. [For Part I see Abstract 5044 (1937).] AUTHORS.

See also Abstract 4931.

ACOUSTICS.

5005. Filtration of Sound. R. B. Lindsay. *J. of Applied Physics*, 9. *pp.* 612–622, *Oct.*, 1938.—The author reviews the theory of infinite acoustic filters and then proceeds to describe a general theory of transmission through a medium in which there are periodic changes in its properties. The theory is adapted to filters containing a finite number of elements and the calculated transmission characteristics of low-pass and high-pass filters are compared with the results of experiment. Good agreement is obtained. The calculations are extended to cover the case of a filter connected to a finite line, *e.g.*, an acoustic filter connected to a tube of finite length. The formula obtained does not allow of simple deductions being made unless special values are assumed for the resonance of the terminating line. Certain special cases are dealt with, however. J. E. R. C.

5006. "Transverse" Acoustic Waves in Rigid Tubes. H. E. Hartig and C. E. Swanson. *Phys. Rev.* 54. *pp.* 618–626, *Oct.* 15, 1938.—Recently considerable work has been done, both theoretical and experimental, on the transmission of electromagnetic waves through dielectric wave guides and hollow metal tubes. An analogous phenomenon is the propagation of transverse acoustic waves in gaseous media confined by rigid cylindrical tubes. Apparatus and methods are described for the production of some of the lower ordered acoustic waves and measurements are made with a tube of circular section filled with air. Measured values of wave-length, threshold frequency, and pressure distribution for some of the possible harmonic wave types are found to be in excellent agreement with theoretical values. Absorption measurements by the standing wave method in which transverse waves are used are suggested. AUTHORS.

5007. Musical Quality of a Violin. H. Meinel. *Zeits. f. techn. Physik*, 19. 10. *pp.* 297–307, 1938.—The results of a number of measurements upon violins are given. Response curves are given for several instruments, some modern and some old, and the effect of various changes in their construction is investigated. The effect of changing the thickness of the wood and also of applying varnish is shown in the response curves reproduced. The "dynamik," namely, the ratio between the quietest and loudest tone obtainable, has also been determined for various violins. It is found, however, that the performance of a violin depends so much upon the circumstances in which it is used that there is little possibility of a physical measurement being sufficient to specify the quality. J. E. R. C.

5008. New Method of Measuring Wave Speeds. S. J. Plimpton. *Am. Phys. Teacher*, 6. *pp.* 203–205, *Aug.*, 1938.—The use of intensity considerations, which are liable to introduce errors in the measurement of wave-lengths and frequencies, is eliminated by a method depending on the extinction of beats with an adjacent tuning fork. The mathematical basis of the method, and applications, are discussed. N. M. B.

5009. Velocity of Sound in A and D_2 at Liquid O_2 and H_2 Temperatures. Second Virial Coefficient of Argon. A. van Itterbeek and O. van Paemel. *Physica*, 5. *pp.* 845–853, *Oct.*, 1938. *In English.*—Measurements were made, using supersonics, on the velocity of sound as a function of pressure in A at: 90·25, 85·73, 80·85 and 78·93° K. and also in D_2 at 20·36° K. The results obtained for A can be represented by the following formula: $W^2 = W^2_0(1 + P \cdot p + Q \cdot p^2)$. From these measurements the second virial coefficient for A was computed between 273° and 80° K. The results are discussed. The authors' preliminary results with D_2 are compared with Schaefer's results. [See Abstract 5395 (1937).] AUTHORS.

5010. Absorption and Velocity of Sound in H_2, D_2, He and Ne. A. van Itterbeek and L. Thys. *Physica*, 5. *pp.* 889–897, *Oct.*, 1938. *In English.*—Measurements on the velocity and the absorption of sound by using supersonics have been made in H_2, D_2, He and Ne between room-temperature and the boiling point of liquid O_2. As was observed by other investigators (Abello, Curtis,) the values found for the absorption in H_2 and He are not in agreement with theory. For H_2, the authors found for the absorption coefficient a (cm^{-1}.) a value which is 20 times the classical theoretical value. For D_2, the experimental value is a factor 10 too great, for He and Ne respectively a factor 4 and 3. From measurements made at the boiling point of liquid O_2 in H_2 containing about 1·5% O_2, an influence is found on the absorption of transitions occurring between even and odd rotational energy levels. At liquid-H_2 temperatures the absorption in H_2 becomes very small and seems to agree at this temperature with the classical theoretical value. For the four gases in question, a decrease is found in the absorption coefficient as a function of temperature. For H_2 and D_2 this decrease seems to be greater than for the two other gases. AUTHORS.

5011. Absorption Measurements of Supersonic Waves in Aqueous Solutions. W. Buss. *Ann. d. Physik*, 33. 2. *pp.* 143–159, *Sept.*, 1938.—Investigations were first made of the supersonic sound field using an optical interferometer. The phenomena thus observed gave no means of measuring the sound intensity. For measurement of the absorption from the sound radiation pressure a method based on capacity measurement was found to be particularly suitable on account of its high sensitivity. The variable capacity measured was that of a pendulum disc of metal and cork, suspended by a bifilar suspension and exposed to the supersonic sound waves, and a fixed plate arranged parallel to the suspended one and a short distance away from it. The capacity variations could be very accurately measured by means of the corresponding variations in the anode current of a h.f. valve oscillator. Measurements were made of the absorption of waves of frequencies from 2150 to 6500 kc./sec. in solutions of sugar, glycerin, $MgSO_4$, Na_2SO_4, NaCl and NH_4Cl and also in CCl_4. The observed increase of absorption in the case of solutions of sugar, glycerin and $MgSO_4$ and the decrease in the case of NaCl and NH_4Cl solutions compared with the value for water is not given accurately by the Stokes-Kirchhoff absorption formula. Comparison of the results obtained is made with those obtained by various investigators. A. W.

5012. Supersonic Dispersion in Liquids. R. Bär. *Helv. Phys. Acta*, 11. 6. *pp.* 472–475, 1938. *In German.*—Following upon measurements [see Abstract 5405 (1937)] of supersonic absorption in certain liquids at very high frequencies (50–80 Mc./sec.) the author has measured the velocity of sound in this region of frequency. By comparison with measurements of sound velocity at lower frequencies it may be decided whether supersonic dispersion may be observable. The following results were obtained for the velocity (m./sec.) of sound in distilled water at 7·5 and at 53 Mc./sec.:—

T	$V_{7\cdot5}$	V_{53}
19·06° C	1480·3	1480·2
20·30	1483·5	1483·1
24·48	1487·55	1487·0
22·70	1491·0	1490·1
23·14	1492·9	1492·2

Later and improved measurements did not show discrepancy between the two velocities. J. J. S.

5013. Excitation of Intramolecular Vibrations in Gases and Gas Mixtures by Collisions. Part V. L. Küchler. *Zeits. f. phys. Chem.* 41. *Abt.B.* 3. *pp.* 199–214, 1938.—Measurements of sound dispersion were made by a method previously described [see Abstract 4625 (1937)], in CO_2, CO_2–He, CO_2–H_2, and N_2O–He, at different frequencies, pressures and concentrations, and at temperatures between 20° and 400° C. It was again noted that a uniform period of adjustment holds for the total heat of vibration. With rise of temperature the number of collisions diminishes in CO_2–He but is practically constant in CO_2–H_2 and in N_2O–He. A parallel is shown to hold between the total number of collisions and the gross dependence of this on temperature. G. E. A.

5014. Absorption Effects in Sound-Transmission Measurements. P. E. Sabine and L. G. Ramer. *Acoustical Soc. of America, J.* 10. *pp.* 102–104, *Oct.*, 1938.—A description is given of measurements of the sound-transmitting properties of a partition set up between two rooms in which the total absorption is varied. It is demonstrated that the ratio of the sound intensities in the two rooms becomes less as the absorption in the receiving room decreases and it is shown that if the correction deduced from the usual formula for the effect of the absorption is made, a constant value for the sound-reduction factor of the partition is obtained as the total absorption in the receiving room is varied over a range of from 7 to 130 units. The significance of this result in connection with the proposed American standards for measuring sound transmission is pointed out. J. E. R. C.

5015. Harmonic Structure of Vowels in Singing. B. Stout. *Acoustical Soc. of America, J.* 10. *pp.* 137–146, *Oct.*, 1938.—A study of the changes that take place in the harmonic structure of sustained vowels in singing with (*a*) pitch constant and intensity varied, (*b*) intensity constant and pitch varied. The vowels chosen were *ah*, *oo*, and *ee*, and the results indicate that the most important change in the harmonic structure which accompanies an increase in intensity is an enhancement of the relative importance of the partials which have frequencies greater than 1800. This enhancement is greatest at the low pitch (D_2, 146·8) for *ah*, greatest at the high pitch (D_3, 293·6) for *ee*, and about the same for all three pitches studied (D_2, A_2, and D_3) for *oo*. The increase in the fundamental which accompanies an increase in total intensity is very slight for *ah*, more for *oo*, and greatest for *ee*. With a rise in pitch, intensity remaining constant, the most important change in the harmonic structure of all three vowels is a decrease in the relative intensity of the partials with frequencies greater than 1800. G. E. A.

5016. New Method for Determining the Uniaural Differential Threshold. J. W. Hughes. *Phil. Mag.* 26. *pp.* 635–650, *Nov.*, 1938.—An interrupted note variable in intensity is added to one of fixed intensity and in phase with it at the ear. It is shown that the variation required provides a very open scale at the differential threshold. Three means of obtaining summation of the notes are described, and the accuracy of the the method for ensuring that the notes are in phase is discussed.
AUTHOR.

***5017. Theory of Chromatic Stroboscope. R. W. Young and A. Loomis.** *Acoustical Soc. of America, J.* 10. *pp.* 112–118, *Oct.*, 1938.—The authors describe a development of the chromatic stroboscope [see Abstract 4131 (1937)] so that pitches can be directly read in terms of cents (one cent is 0·01 semitone). The combination of frequencies from a musical chord is applied to a lamp, so that the modulated light falls on a series of 12 stroboscopic discs, each of which has 7 rings of alternate light and dark elements, the illumination, when the discs are rotated at the correct speed, indicating the pitches of notes, if present; likewise flatness or sharpness is indicated. Because of the impossibility of obtaining gear ratios corresponding to the equi-tempered scale, the compromise ratios of 89/84 and 107/101 are adopted to minimise errors, the resultant error in pitch being less than 0·1 cent. The chromatic gear-box is therefore provided with 12 shafts carrying stroboscopic discs at relative speeds corresponding to the scale of semitones within the above error, the whole range of a piano then being covered. The flashing amplifier is provided with automatic gain control; inputs corresponding to the range of 60 db operate the discharge lamp adequately. For measuring mistuning, a calibrated fine adjustment of speed permits measurement within ± 50 cents, with a sensibility of 1 cent. [See also Abstract 4618 (1938).] L. E. C. H.

5018. Acoustic Experiments on Fresnel Diffraction. H. K. Schilling. *Am. Phys. Teacher*, 6. *pp.* 265–269, *Oct.*, 1938.—A description of experiments on sound diffraction using modern equipment. Sound waves of length 2 cm. are passed through slits of width which can be varied between 1 and 12 cm. The source of sound is in a box from which the waves emerge horizontally to be received by a microphone and oscillograph. The microphone can be moved horizontally in a circle. As the width of the slit is increased, the deviation of the first "dark fringe" decreases, the energy in the geometrical beam increases, the number of fringes increases, and the largest number of minima possible for a given slit width w is w/λ. By using narrow reflecting strips, the effects of destructive and constructive interference are studied. Effects with a double slit, multiple slits, circular apertures and curved reflectors are also examined. In shadow effects the Arago "bright spot" is obtained with a disc 20 to 30 cm. in dia. The term phonoptics is proposed for these experiments. G. E. A.

***5019. Modified Phonodeik. J. E. Shrader.** *Am. Phys. Teacher*, 6. *pp.* 269–271, *Oct.*, 1938.—Description of a phonodeik which requires less skill for its construction than Miller's. The diaphragm is of thin cover glass, and the thin needle used as spindle to carry the mirror is supported by fine tungsten wires ending in fine springs. The effects are shown by means of a rotating mirror operated by a small motor with reduction pulleys. Frequencies up to 3000 have been recorded, and two records shown give the beats from two tuning forks and the note of a trombone with vibrato. G. E. A.

5020. Acoustics. Part II. E. Meyer. *Die Physik*, 6. 4. *pp.* 127–162, 1938.—In continuation of an earlier paper [see Abstract 3842 (1934)] an account is given of recent progress in acoustics. The following sections are dealt with: General acoustics; methods of measurement and analysis; electro-acoustics; music; building acoustics; physiological acoustics; noise measurement and reduction; supersonics. J. E. R. C.

5021. Frequency Ratios of the Tempered Scale. C. Williamson. *Acoustical Soc. of America, J.* 10. *pp.* 135–136, *Oct.*, 1938.—The theory of the tempered scale may present mathematical difficulties to the student of music, and common fractions are more likely to be understood as a means of expressing the frequency ratios of the scale. Helmholtz gave the intervals of the tempered scale in a series of common fractions, and Harker [see Abstract 2739 (1937)] has furnished the decimal equivalents to 8 significant figures. Application of the method of continued fractions brings out that Helmholtz has given one of the convergents in 7 of the 11 cases. It is suggested that the convergents be used in all cases. The table would then read: 89/84, 55/49, 44/37, 63/50, 295/221, 99/70, 442/295, 100/63, 37/22, 98/55, 168/89. The product of pairs symmetrically chosen is 2 in every case. G. E. A.

See also Abstract 4751 and

3407B. Voice Frequency Spectrometer. E. Freystedt and F. Bath.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***5022. Relative and True Power Factors of Air Capacitors. A. V. Astin.** *Bureau of Standards, J. of Research*, 21. *pp.* 425–456, *Oct.*, 1938.—An a.c. bridge for measuring the differences of power factor of capacitors to $\pm 5 \times 10^{-7}$ in the commercial and audio-frequency range is described. The bridge is essentially of the Schering type, with a Wagner ground connection, and may be arranged for either high- or low-voltage use. The theory of the bridge is given for both perfect and imperfect balance, the latter permitting evaluation of the error due to residual voltages. Variable low-loss air capacitors for use in the bridge are described. It is shown that the power factor of a guard-ring air capacitor is not necessarily zero, and a method is given for determining the true value of this power factor. AUTHOR.

See also Abstracts 4776, 5031, 5043, 5067, 5074.

CONDUCTION AND DISCHARGE IN GASES.

5023. Rate of Vaporisation of Mercury from an Anchored Kathode Spot. L. Tonks. *Phys. Rev.* 54. *pp.* 634–639, *Oct.* 15, 1938.—Two major difficulties which interfere with the measurement of the vaporisation of Hg at a free kathode spot are the spray and the normal evaporation from the free surface. By anchoring the spot the spray has been eliminated, and by a specially designed, water-cooled kathode structure the free surface has been limited to small areas of controllable size.

By means of a calibrated feed mechanism, Hg was fed to the kathode as fast as it vaporised. Measurements were made over a range of arc current, cooling water temperature, and exposed area. The rate of vaporisation (gm./coulomb) increased with arc current, temperature, and exposed area, all due to increased normal evaporation. The rate may also increase with arc current, because of cumulative effects within the spot itself. Extrapolated to zero arc current the rate was found to be approximately $2\cdot5 \times 10^{-4}$ gm./coulomb. This lies within the limits set by von Issendorf. It means that eight elementary charges pass through the arc for every atom evaporated. AUTHOR.

5024. Ionising Radiation Accompanying a Spark Discharge. H. Raether. *Zeits. f. Physik*, 110. 9–10. *pp.* 611–624, 1938.—It is shown with a cloud chamber that a spark in H_2, air or O_2 is accompanied by a radiation which ionises the gas. Measurement on the liberated photoelectrons indicates a radiation of 800–1000 Å; its absorption coefficients in the three gases respectively were 2 cm^{-1}., $0\cdot8$ cm^{-1}. and 5 cm^{-1}. The characteristics of the radiation indicate that it is identical with that produced in counter discharges. The presence of such a radiation in solar radiation would explain various phenomena associated with the ionosphere. F. C. C.

5025. Initial Recombination of Ions. L. Onsager. *Phys. Rev.* 54. *pp.* 554–557, *Oct.* 15, 1938.—The probability that a pair of ions of given initial separation will recombine with each other is computed from the laws of Brownian motion, which is the proper procedure whenever the Langevin factor equals unity, as in gases at high pressures. In the absence of forces other than the Coulomb attraction, the probability of escape equals the reciprocal of the Boltzmann factor. This result includes the correlation between temperature and pressure coefficients of the ionisation by light particles previously predicted by Compton, Bennett and Stearns, if one allows their basic hypothesis about the laws which govern the initial separation of the ions. The effect of an electric field is to increase the fraction of escaping ions by a factor which in the incipient stage of the effect is proportional to the field intensity and independent of the initial distance, although it depends on the orientation of an ion pair. The predicted increase of the ionisation current is a little more than 1% for every 100 V/cm., which accounts for the observed effects of fields exceeding 1500 V/cm. A reasonable amount of columnar recombination would help to explain the proportionately greater effects of weak fields. The inferred initial separations of the ions are apparently compatible with present knowledge of electron scattering and attachment. AUTHOR.

***5026. General Theory of Double-Focusing Mass-Spectrographs. R. Herzog and V. Hauk.** *Ann. d. Physik*, 33. 2. *pp.* 89–106, *Sept.*, 1938. —A formula has been previously derived to express the form of the pole-shoe perimeter necessary to fulfil the double focusing condition in a double-focusing mass-spectrograph comprising a radial electric and a homogeneous transverse magnetic field [see Abstract 2551 (1938)]; the form of the image curve in such a spectrograph is now derived and discussed in detail in relation to the pole-shoe curve. The angle of incidence of rays on the image curve and the dispersion are also deduced. It is shown clearly how in the limit the case of rectilinear pole-shoe and image curves is attained. For a given angle of incidence of rays on the photographic plate the optimum angle of deflection is 120°. An appreciable increase of dispersion can only be obtained in the case of very oblique incidence of the rays on the plate. J. E. K.

5027. Effective Cross-Section of Positive Alkali Ions. K. H. Bracewell. *Phys. Rev.* 54. *pp.* 639–643, *Oct.* 15, 1938.—Determinations have been made of the mean free path and effective cross-section of Na^+ ions in H_2, N_2 and O_2. A modified form of the Dempster mass-spectrograph was used over a range of ion velocities from 40 to 400 V. Curves showing the velocity distribution of the ions after passing through the gases indicate that the essential factor in the ion absorption is neutralisation, though some retardation and angular scattering may occur. Over the voltage range observed the mean free paths in N_2 and O_2 are almost identical. The results for the effective cross-sections show that the effective size of an ion is dependent on its speed; at high speeds it apparently makes a number of kinetic theory collisions without removal from the beam. The curves turn sharply upwards at speeds less than 50 V, appearing to approach kinetic theory values of the cross-section at zero potential. J. E. R.

5028. Sputtering of Oxide-Covered Mg Surfaces. R. W. Ditchburn and K. I. Roulston. *Cambridge Phil. Soc., Proc.* 34. *pp.* 620–624, *Oct.*, 1938.—The rate of sputtering of Mg in O_2 was observed with an apparatus which permitted the field immediately in front of the target to be reversed. Change in the sign of the field did not affect the rate of sputtering which remained abnormally low. It is therefore concluded that, while the low rate is in some way due to the presence of an oxide film, it is not due to charged particles being returned to the kathode by the electric field, as had been suggested by other workers. [See Abstract 4153 (1937).] AUTHORS.

See also Abstracts 4827, 4895, 4896, 4897, 4898, 4899, 4900, 4901, 4902, 5003.

CONDUCTION IN SOLIDS AND LIQUIDS.

5029. Resistance of a Metal at Low Temperatures and Matthiessen's Rule. G. P. Dube. *Cambridge Phil. Soc., Proc.* 34. *pp.* 559–567, *Oct.*, 1938.—By solving the fundamental integral equation an expression is obtained for the electrical resistance which takes into account, to the first approximation, the mutual influence of the impurities and the lattice vibrations. It is found that deviations from Matthiessen's rule are to be expected and that these deviations are surprisingly large. The formulæ derived only indicate the trend of the resistance curve, but this trend is not confirmed by experiment. Whereas the theory indicates that the mutual influence of the impurities and the lattice vibrations should decrease the electrical resistance, the experimental results of Grüneisen on copper show that, when deviations from Matthiessen's rule occur, the resistance is increased. AUTHOR.

***5030. Stability of Zero of Valve Electrometer Circuit. F. Müller and W. Dürichen.** *Phys. Zeits.* 39. *pp.* 657–661, *Sept.* 15, 1938.—The two essential conditions to be fulfilled in a valve electrometer circuit if a wandering zero is to be avoided are found to be, (1) the smallest possible grid current and, (2) a sufficiently large potential sensitivity. F. C. C.

***5031. Determination of Absolute Ohm, Using an Improved Self Inductor. H. L. Curtis, C. Moon and C. M. Sparks.** *Bureau of Standards, J. of Research,* 21. *pp.* 375–423, *Oct.*, 1938.—A second determination of the value of the absolute ohm has been completed.

The same method as that previously described has been followed. [See Abstract 1313 (1936).] This required the computation of the inductance of a solenoid from its measured dimensions and the electrical measurement of the same inductance in terms of resistance and time. Refinements were made in many of the details of measurement. Two important improvements were introduced. A new inductor was constructed in which the wire was wound in a screw thread of uniform pitch cut in a glass tube. The error in the computed inductance which resulted from the variations in pitch has been practically eliminated, whereas in the previous inductors this introduced one of the largest uncertainties. The other improvement was in the a.c. bridge measurements, where the effect of the capacitance to earth of the inductor was evaluated. The result of this determination is 1 NBS international ohm = 1·000 479 absolute ohms. By estimating the capacitances to earth of the inductors used in the previous work, corrections have been applied to the results there obtained. The weighted average of this result and the corrected results from the previous publication is 1 NBS international ohm = 1·000 468 absolute ohms. The authors are of the opinion that this weighted average differs from the true value by less than 20 parts in a million. AUTHORS.

5032. Influence of Magnetic Fields on Persistent Currents in a Closed Supraconducting Circuit. K. C. Mann, H. G. Smith and J. O. Wilhelm. *Phys. Rev.* 54. *pp.* 758–766, *Nov.* 1, 1938.—A study has been made of the effects of external magnetic fields in preventing persistent currents from flowing in a closed supraconducting circuit, in order to determine as closely as possible the field strength at which the first trace of electrical resistance appears. In agreement with earlier work by a less accurate method and with the resistance measurements of de Haas, but in contradiction to the idealised theory of the transition state, it is clearly shown that no resistance appears until the mean magnetic induction within the specimen becomes considerable. It has been found further that the amount of resistanceless current that a cylindrical specimen can carry under these conditions has a well-defined limit. The effects of very small quantities of impurities of different types have also been investigated and have been found greatly to affect the above results. When the persistent current strength was slightly above its equilibrium value, it required a measurable time to decay; the behaviour was similar to the relaxation effects observed in the study of magnetic and thermal properties of supraconductors. [See following Abstract.] AUTHORS.

5033. Relaxation Effects Connected with the Transition Between the Supraconducting and Normal States. H. G. Smith and K. C. Mann. *Phys. Rev.* 54. *pp.* 766–770, *Nov.* 1, 1938.—Several authors have suggested that the relaxation effects frequently observed in experiments on the magnetic properties associated with supraconductivity may be due to the slow decay, caused by a very small resistance, of eddy currents in the specimen. Similar relaxation effects have recently been observed [see preceding Abstract] in experiments on persistent currents in a closed supraconducting circuit. Viewed in the light of a marked parallelism in behaviour of all time effects, these experiments definitely confirm the above suggestion. Further, a simple thermodynamic argument shows that the same cause will produce relaxation in the thermal equilibrium, and so will account also for the time effects in the calorimeter experiments of Keesom and van Laer. [See Abstract 3219 (1937).] AUTHORS.

5034. Conductance of HCl in Dioxane-Water Mixtures. B. B. Owen and G. W. Waters. *Am. Chem. Soc., J.* 60. *pp.* 2371–2379, *Oct.*, 1938.—The equivalent conductance of HCl has been measured in 20, 45, 70 and 82% dioxane solutions at 15, 25, 35 and 45°. The experimental data closely follow the Onsager limiting slope in 20 and 45% dioxane solutions at high dilutions. Ionic association is too pronounced in 70 and 82% dioxane for convergence with the limiting slope within the accessible concentration range. In a given solvent mixture, it was shown that the temperature dependence of the limiting conductance is linear, and the variation with viscosity can be expressed by $\Lambda_0\eta_0^s = r (s < 1)$. The effect of the dielectric constant upon conductance and ionic association was illustrated by graphs, and by evaluation of the dissociation constant of HCl in 70 and 82% dioxane solutions. At 25° the estimated values of the dissociation constant are $7 \cdot 7 \times 10^{-3}$ and $2 \cdot 0 \times 10^{-4}$ in 70 and 82% dioxane solutions, respectively. Rough values of the heat and entropy of ionisation were also reported. AUTHORS.

5035. Conductance of Mixtures of Lead Abietate and Tributyl-Ammonium Chloride in Toluene. V. Deitz and R. M. Fuoss. *Am. Chem. Soc., J.* 60. *pp.* 2394–2401, *Oct.*, 1938.—The conductances of lead abietate and of tributylammonium picrate and chloride in toluene at 35° have been determined at 60~ by means of the Schering bridge. The polar moment of lead abietate in toluene is zero. Values for the other two salts check values in the literature. The reaction between lead abietate and tributyl-ammonium chloride in aromatic hydrocarbons has been studied. It is suggested that an intermediate soluble mixed salt, PbAbCl, is formed. The moment of the corresponding ion pair is $8 \cdot 6 \times 10^{-18}$ and its dissociation constant is approximately $1 \cdot 5 \times 10^{-17}$. An analytical method for the determination of lead in compounds soluble in aromatic hydrocarbons is described. The method depends on the fact that dry HCl precipitates $PbCl_2$ quantitatively from benzene or toluene solutions of lead salts. The preparation of pure lead abietate is described.

AUTHORS.

***5036. Equivalent Circuit of Conductivity Cells. S. F. Acree, E. Bennett, G. H. Gray and H. Goldberg.** *J. Phys. Chem.* 42. *pp.* 871–896, *Oct.*, 1938.—Oscillographic measurements are reported on electrolytes between bright Pt electrodes. The frequencies used were 60 and 240~. It is shown that, so long as the impressed voltage was less than the e.m.f. of polarisation of the solution, the cell was electrically equivalent to a resistance in series with a leaky condenser, and that the component impedances were independent of frequency and voltage. If the impressed voltage exceeded the e.m.f. of polarisation, the capacitance of the equivalent condenser (which is due to the film at the surface of the electrode) increased a great deal. W. H. W.

See also Abstracts 4898, 4984, 5067, 5081 and
3392B. New Reflecting Galvanometer. K. W. Kögler.
3399B. Measurement of Small D.C. Potentials. L. Merz.

DIELECTRICS AND CAPACITANCE.

5037. Anomalous Dispersion and Free Rotation. A. Budó. *Phys. Zeits.* 39. *pp.* 706–711, *Oct.* 15, 1938.—This entirely mathematical paper investigates the behaviour of molecules with rotatable groups in the h.f. alternating field and the effect of free rotatability on anomalous dispersion. The axes of rotation in the groups are assumed to be parallel and all intermolecular effects are neglected. The determination of the average moment in the alternating field requires that of the distribution function, which, in the static field, is assumed to be that of Maxwell-Boltzmann. The refractive and absorptive indexes are determined from a formula (now derived) as a function of the frequency. H. H. Ho.

5038. Dipole Rotation in Solutions. P. Girard and P. Abadie. *Phys. Zeits.* 39. *pp.* 691–692, *Oct.* 1, 1938.—Dispersion and absorption curves obtained for propyl alcohol and solutions of propyl alcohol in hexane, benzene and ether show the effect of the solvent in restricting the rotation of the polar molecules of the propyl alcohol. E. R.

5039. Solvent Effect on Dipole Moments of Amines. E. G. Cowley and J. R. Partington. *Chem. Soc., J. pp.* 1598–1601, *Oct.*, 1938.—The polarisations and moments of some amines in various solvents have been determined and the results considered in relation to the effect of the solvent. The variations observed between the measurements are small. Mention is made of the results obtained with certain other compounds which show a similar behaviour and a discussion of the influence of the solvent on these substances is given. [See also Abstract 3820 (1938).] AUTHORS.

5040. Polymerisation of Styrolene in 50-Cycle Electric Fields and of Oil in Condensers. A. Liechti. *Helv. Phys. Acta*, 11. 6. *pp.* 477–496, 1938. *In French.*—Oil employed for cable and condenser insulation undergoes a physico-chemical change resulting in the production of wax, or " x ", which is a product of polymerisation. For paraffin, the reaction is described by $C_nH_{2n+2} + C_mH_{2m+2} = C_{n+m}H_{2(n+m)+2} + H_2$. The mechanism of polymerisation comprises (*a*) production of nuclei by activation of single molecules, rendering them susceptible to linking with similar molecules ; (*b*) formation of chains without complete saturation of free valencies ; (*c*) saturation of lateral free valencies. An experimental study on styrolene, under various maintained conditions of heat and d.c. and a.c. electric fields supports the hypothesis that polymerisation may occur without the presence of small air or gas pellicules being necessary at the commencement of the process, the observed presence of gas being the result of a secondary phase in the chemical action. M. G. S.

5041. Dispersion and Absorption of Polar Substances. P. Debye and W. Ramm. *N. Cimento,* 15. *pp.* 226–231, *April,* 1938. *In German.*—The paper is in the nature of a summary of recent work by Debye and his collaborators on polar liquids, *e.g.*, ethyl alcohol, with particular reference to their dispersion and absorption of electromagnetic waves of 2-100 cm. The bearing of the work on the theory of liquids is discussed. C. J. B. C.

5042. Rôle of Solid Friction in Synthetic Dielectrics. A. Gemant. *J. of Applied Physics,* 9. *pp.* 730–734, *Nov.*, 1938.—New synthetic dielectric materials, both of the ceramic and resinous type, exhibit, among other features, a high grade of homogeneity. This will not only affect favourably the mechanical properties, the electrical breakdown strength and the dielectric losses due to layer mechanism, but will also reduce losses due to dipole rotation. If, for example, dipolar constituents rotate at all in the solid state, dissipation of energy will be caused by the solid friction, which has to be overcome. This latter, on the other hand, can be shown to be related directly to the imperfections of the material, thus indicating the beneficial effect of a homogeneous structure on the dielectric loss angle. AUTHOR.

5043. Comparison of Capacities at Radio Frequencies. W. Vaughan. *Phil. Mag.* 26. *pp.* 521–557, *Oct.*, 1938.—Across the tuned grid circuit of a valve oscillator are connected two parallel branches, each consisting of a capacity (C_a or C_b), and a resistance, (R_a or R_b) in series. The capacities are the pair to be compared. R_a and R_b are made zero in turn, while the other resistance is adjusted so that the total admittance of tuned and shunt circuits is restored to the same value. Then $R_b/R_a = (C_a/C_b)^2$ provided $R^2C^2\omega^2 \ll 1$, where ω is the pulsatance. The behaviour of the circuit is discussed fully, and it is concluded that the method is capable of comparing capacities between 5 and 500 $\mu\mu$F at frequencies between 100 and 2000 kc./sec., with a consistency of 0·2 to 0·3%. Correction for stray capacity is not required. J. P. A.

5044. Electrodynamic Volume and Porosity of Metallic Particles. H. Löwy. *Phil. Mag.* 26. *pp.* 453–457, *Oct.*, 1938.—Expressions are derived for the electrodynamic volume and porosity of metallic particles dispersed in a dielectric, for cases in which the particles are assumed to be hollow bodies or bodies with a sponge-like structure. E. R.

See also Abstracts 5022, 5047, 5048.

ELECTROCHEMISTRY.

5045. Transport Numbers of Paraffin-Chain Salts in Aqueous Solution. Part II. G. S. Hartley. Part III. C. S. Samis and G. S. Hartley. *Faraday Soc., Trans.* 34. *pp.* 1275–1305, *Nov.*, 1938.—In Part II the explanation of the changes in electrical mobilities with concentration in solutions of paraffin-chain salts in terms of micelles is reviewed. Certain objections to the micelle theory are examined. In Part III further measurements on conductivities and transport numbers of paraffin-chain salts in aqueous solutions are recorded. Transport measurements by the balanced boundary and Hittorf methods are compared. The qualitative generality of the changes in the equivalent conductivities (mobilities) with concentration is confirmed. When the gegenion associated with a given paraffin-chain ion is changed, changes in these conductivities are observed which must be due to changes not only in the fraction of the gegenions attached to the micelle but also in the size of the latter, and always in the direction that the greater the fraction attached the larger the micelle (and the lower the "critical" concentration). In determining these changes, specific properties of the gegenions are at least of equal importance to their valence. Thus the fraction of gegenions attached to, and the size of, the cetyl pyridinium micelle *decrease* in the order $I^- > Br^- > Cl^- >$ (Acetate)$^- > SO_4^{=}$, with (oxalate)$^{=}$ lying somewhere between Br^- and $SO_4^{=}$. On the other hand for dodecyl sulphates the order is probably $Cu^{++} > Ag^+$. A correlation of this sequence with solubility of the salts in organic solvents is pointed out and a mechanism explaining it suggested. Degree of gegenion attachment and size vary in such a way that the micelle mobility (for a given paraffin-chain ion and concentration) appears to depend very little on the nature of the gegenion but very much on its valence, a fact which is very simply expressed, though not explained, in terms of the ζ-potential. Measurements on mixtures with simple salts confirm the effect of the latter, indicated by comparison with diffusion measurements, in levelling-out these specific variations of size. Measurements on mixtures of cetyl pyridinium sulphate and chloride confirm that it is the latter, despite its lower valence, which is preferred by the micelle for attachment to, or "solution" in, its outer layer. [For Part I, see Abstract 2852 (1936).] AUTHORS.

5046. Glass Electrode in Alkaline Solutions. D. O. Jordan. *Faraday Soc., Trans.* 34. *pp.* 1305–1310, *Nov.*, 1938.—The deviation of glass electrode potentials from perfect H-electrode potentials has been determined for alkaline solutions containing Na, Li, K, Ca, Sr and Ba ions at different pH values and ionic concentrations. An empirical relationship has been derived relating the glass electrode deviation, the pH as determined by the glass electrode and the ionic concentration. AUTHOR.

5047. Capacity of Mercury Electrode in Solutions of Capillary-Active Organic Substances. A. Ksenofontov, M. Proskurnin and A. Gorodetzkaja. *Acta Physicochimica,* 9. 1. *pp.* 39–44, 1938. *In English.*—Curves of Hg electrode capacity are obtained in solutions of capillary-active organic substances, and a physical interpretation of the shape of these curves is given. It is established that the minimum capacity in a saturated solution of a capillary-active organic substance decreases with an increase in the length of the chain in the organic molecule. AUTHORS.

5048. Capacity of the Solid Mercury Electrode. A. Gorodetzkaja and M. Proskurnin. *Acta Physicochimica,* 9. 1. *pp.* 45–50, 1938. *In English.*—It is shown by measurements of the capacity of solid and liquid Hg in an electrolyte solution and in the presence of a capillary-active substance that both the capacity per cm². of true surface area and the surface area of the Hg remain practically unchanged upon freezing. AUTHORS.

See also Abstracts 4770, 4827.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

5049. Determination of e/m from the Hα-Dα Interval. R. C. Williams. *Phys. Rev.* 54. *pp.* 568–572, *Oct.* 15, 1938.—Photographs were taken with a 3 mm. étalon of the interference pattern of Hα and Dα from a discharge in the two gases mixed in equal proportions. The interval between the intensity peaks due to the low frequency major components of the two isotopes was measured with the microphotometer used as a comparator. Corrections were made to the observed positions of the intensity peaks to change them to the positions of the centres of the components. These corrections were based on the intensities, positions, and half-intensity breadths of the components as experimentally determined, and upon certain assumptions relative to the shape of the components. An interval between components of $4 \cdot 14700 \pm 0 \cdot 0004$ cm^{-1}., when reduced to vacuum, was obtained. By combining this with recently determined values of the atomic weights of H and D as reported by Livingston and Bethe, the wave number of Hα as determined by Houston, and the physical Faraday as computed by Birge, a value of $1 \cdot 7579 \pm 0 \cdot 0004 \times 10^7$ e.m.u./gm. is obtained for the value of e/m. [See Abstract 4933 (1938).] AUTHOR.

5050. Determination of e/m from Refraction of X-Rays in a Diamond Prism. J. A. Bearden. *Phys. Rev.* 54. *pp.* 698–704, *Nov.* 1, 1938.—Measurements of the index of refraction of the CuK$_\beta$ line by a diamond prism have been made with an estimated accuracy of one part in 10,000. These measurements together with the quantum theory of dispersion and the ruled grating wave-length of the CuK$_\beta$ line afford a method of evaluating e/m with an accuracy comparable to that of previous determinations by other methods. The value of e/m is given by the equation $e/m = \delta[(\lambda^2 \rho F/2\pi W)\ \Sigma_1^s N_s(1 + A)]^{-1}$, where δ, λ, ρ, F, N, and W have their usual meaning and A is the factor which takes into account the electronic binding. For C and a $\lambda^{2\cdot75}$ law of absorption, the value of the $\Sigma_1^e = 6\cdot0163 \pm 0\cdot0006$. Using $\delta = 9224\cdot4 \times 10^{-9}$, $W = 12\cdot0148$, $\rho = 3\cdot5154$, $F = 96513\cdot1$, $\lambda = 1\cdot39220$ Å, one obtains $e/m = (1\cdot7601 \pm 0\cdot0003) \times 10^7$ e.m.u. This bound electron value is higher than most previous spectroscopic determinations but is in excellent agreement with the free electron results of Dunnington [see Abstract 5453 (1937)]. AUTHOR.

5051. Electron-Optical Investigation of the Passage of Slow Electrons (0-200V) through Metal Foil. H. Katz. *Ann. d. Physik*, **33**. 2. *pp*. 160–168, *Sept*., 1938.—Investigation of the electron diffraction patterns obtained with Ag foil using secondary electrons gave the quite unexpected result that slow electrons can pass in very considerable numbers through chemically deposited Ag foil. The permeability is equally great over the whole surface and can be observed even for electron velocities very close to zero voltage. With electrons of low velocity (of the order of 10 V) electron images can be obtained through the foil of objects placed in the path of the beam, thus showing that the electrons pass through the foil without any marked change of direction. At higher electron velocities the electron images obtained indicate that the electrons after passage through the foil have velocities which fall into two groups. Foils produced in other ways and with other materials show weaker permeability than chemically deposited foils. The permeability is also lower after long exposure to the electron stream. [See following Abstract.] A. W.

5052. Passage of Slow Electrons (0-200 V) through Metal Foil. H. Katz. *Ann. d. Physik*, **33**. 2. *pp*. 169–184, *Sept*., 1938.—Ag foil deposited chemically on glass has a surprisingly high transmission value for slow electrons [see preceding Abstract]. The permeability is affected by the previous treatment to which the foil has been subjected. It is found that the transmitted electrons are divided into two well defined groups, one having velocities of only a few volts (secondary electrons), while in the other group the electrons have nearly their original velocity. The "free" permeability, *i.e*., the fraction of the electrons passing through the foil without energy loss or change of direction, passes through a maximum as the electron velocity is increased. The different behaviour of the total permeability for different foils can be explained by their different behaviour as regards the free permeability. From the existence of a minimum of the free permeability at an electron velocity of a few hundred volts it is concluded that there is a corresponding maximum of the emission of secondary electrons. A. W.

5053. Straggling of Electrons due to Radiation and Ionisation Loss. H. C. Corben. *Cambridge Phil. Soc., Proc*. **34**. *pp*. 540–549, *Oct*., 1938.—The probability of an electron having an energy greater than a certain fraction of its initial energy after traversing a certain thickness of matter is calculated for different values of the initial energy. Whereas in previous calculations the energy losses by radiation and by ionisation have been treated separately, and the results added, the two types of losses are here combined and their effect on each other included. The results may be compared with those of experiment for values of the initial energy up to a few times the critical energy of the substance traversed. The theoretical values obtained are found to give better agreement with the results of experiment than do those obtained by the less accurate method. AUTHOR.

5054. Slowing Down of Neutrons in a Proton Gas. K. Husimi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 780–792, *Sept.*, 1938.—This paper deals with a gas kinetic calculation of the process of slowing down a group of neutrons in a gas of protons having a Maxwellian energy distribution. The energy distribution of neutrons in the stationary state is established by assuming a constant source of neutrons with a prescribed energy distribution and a finite capture probability. The primary purpose of the investigation is to clarify the question of how far the naïve exception of neutrons being clarified into fast and thermal groups can be maintained from the more rational gas formalism. The calculation is a direct extension of the pioneer work of Fermi, whereby the latter's treatment of static protons is altered to one in which the protons are subjected to thermal agitation. H. H. Ho.

***5055. Production of Collimated Beams of Monochromatic Neutrons in the Temperature Range 300°-10° K. L. W. Alvarez.** *Phys. Rev.* 54. *pp.* 609–617, *Oct.* 15, 1938.—An electrical velocity selector is described, which allows the production and use of highly collimated beams of pure thermal neutrons. The mean temperature of the neutrons may be varied from 300° K. to an undetermined lower limit, probably less than 10°K., without the use of refrigerants. The temperature width of the neutron "line" is also adjustable. Fast neutron effects are completely eliminated. Qualitative verification of the $1/v$ law for B has been extended to 30° K. The intensity of neutrons available from the cyclotron allows counting rates of 1000 per min. to be obtained at 30° K., with a source-detector distance of 4 m., and an angular spread of 1°. AUTHOR.

5056. Secondary Electron Emission of Beryllium. R. Kollath. *Ann. d. Physik*, 33. 4. *pp.* 285–299, *Oct.*, 1938.—The secondary emission of Be was investigated under widely differing conditions of experiment. Sheets exhausted in high vacuum give a very small output (max. $0{\cdot}4_2$). Compact Be plates exhibit a yield about ten times as great (max. 4–5). Oxidation of the sheets treated *in vacuo* in a glow discharge in O_2 lead to the highest output of 2 to 2·5. Oxidation in an atmosphere of O_2 with simultaneous heating yields after a long time (dependent on the pressure of O_2) a maximum output of 4–5. On glowing exhausted sheets in as high a vacuum as possible a rise in the output occurs if a definite temperature is attained which lies in the region of 700–800° C. The conclusion is reached that, at any rate for Be, oxidation alone does not lead to the highest obtainable output, but that additional processes in the sheet are necessary which are connected with the arrangement of the atoms in the sheet. J. J. S.

5057. Secondary Electron Emission from Wire Gauze. M. Sandhagen. *Zeits. f. Physik*, 110. 9–10. *pp.* 553–572, 1938.—Investigations were made of the output and distribution of the secondary electrons released by a beam of primary electrons from a fine-meshed wire gauze located between two annular discs 8 mm. apart maintained at potentials variable with respect to one another and to the gauze. By variation of the gauze diameter the effects of the suction and retarding fields on the paths of the secondary electrons were separated from one another. For the types of reflector nets commonly used in the valve industry the efficiency was found to be nearly constant and independent of the wire material, but small in comparison with that of a massive plate. On this account the possibility is suggested of utilising small plates instead of gauze for secondary electron multiplication. A. W.

See also Abstracts **4893, 4901, 4906, 5026** and

3416B. Symmetry Problem of Braun Tubes. H. Pieplow and E. Steudel.
3417B. Spherical Aberration of Magnetic Lenses. H. Becher and A. Wallraff.
3418B. Optics of Electric Charges. P. Bricout.

ELECTROSTATICS.

5058. Contact P.D. between Ba and Mg. P. A. Anderson. *Phys. Rev.* 54. *pp.* 753–757, *Nov.* 1, 1938.—With the purpose of subjecting the electronic method of contact potential measurement to a thorough test for consistency with independent photoelectric work function determinations, the Volta potential Ba-Mg has been measured for some 30 pairs of surfaces and the results compared with recent careful photoelectric studies of these metals. Each surface was prepared by fractionally distilling the metal in a gettered vacuum and revaporising a middle fraction to form a thick film on glass at room-temperature. Each film was measured a few seconds after deposition and tubes of two different designs used to minimise the possibility of errors originating in tube geometry. The majority of the observed Volta potentials fell within the range of values predicted by the photoelectric data, 1·08–1·16 V, and no values below this range were found. The Mg films were largely responsible for variations in the Volta potential and a few gave potential settings sufficiently low (work functions sufficiently high) to raise the observed Volta potentials to a maximum of 1·26 V. Since all probable contaminations should lower the work function the maximum value is regarded as the most reliable. Assuming a work function of 2·52 eV for Ba this gives 3·78 eV for the work function of Mg. Observations on the optical reflection of the Mg surfaces suggest, however, that a work function of 3·65 ± 0·05 eV may be characteristic of mirror-like surfaces of the metal; 3·78 eV of macrocrystalline (matte) surfaces. AUTHOR.

See also Abstract 4899.

MAGNETISM AND ELECTROMAGNETISM.

5059. Paramagnetism of Mn. A. Serres. *J. de Physique et le Radium*, 9. *pp.* 377–380, *Sept.*, 1938.—The effect of temperature on the paramagnetism of crystallised Mn has been investigated. In contradiction to the theory proposed by Néel [see Abstract 1874 (1936)] the paramagnetism decreases slowly but continuously with increasing temperature in the range −183° to +600°. At lower temperatures the magnetisation passes through a minimum, whilst at higher temperatures it tends to a maximum above 600°, probably at the temperature of the $\alpha \rightarrow \beta$ transformation. No anomaly in the paramagnetism has been found near 350° to correspond with the observed anomaly in the specific heat. W. R. A.

5060. Paramagnetic Dispersion in a Single Crystal. P. Teunissen and C. J. Gorter. *Physica*, 5. *pp.* 855–856, *Oct.*, 1938. *In English.*—Paramagnetic dispersion in a crystal of ferric alum is isotropic with respect to the orientation of the crystal axes. [See also Abstracts 3403 and 4244 (1937).] AUTHORS.

5061. Suitability of Diamagnetic Crystal for Magnetic Field Measurement. R. G. Stansfield. *Cambridge Phil. Soc., Proc.* 34. *pp.* 625–633, *Oct.*, 1938.—The magnetic anisotropy of crystals of calcite and sodium nitrate does not alter between room-temperature and liquid nitrogen temperature. Using such diamagnetic crystals, it is easy to compare strong magnetic fields to 1 part in 1000. The effect is large enough for the measurement of fields of the order of 100 gauss, but in small fields the accuracy is limited by ferromagnetic contamination. AUTHOR.

*5062. **Method for Obtaining a Uniform Magnetic Field. J. W. Clark.** *Rev. Sci. Instruments*, 9. *pp.* 320–322, *Oct.*, 1938.—Describes the design and construction of a coil, wound on a hollow wooden sphere or ellipsoid and distributed so that the number of turns per unit of axial length is constant, which provides a field uniform within 1% over a large part of the volume enclosed. Uniform fields of the order of hundreds of oersteds (or, by the use of special cooling, a few thousand oersteds) can be obtained by this method more cheaply than by means of iron-cored magnets, and with much greater uniformity perpendicular to the lines of force than by means of Helmholtz coils. C. E. W.

*5063. **Simple Magnetometer for Moderate to Very Strong Fields. A. Deubner.** *Phys. Zeits.* 39. *pp.* 716–718, *Oct.* 15, 1938.—A small, soft iron rod is mounted perpendicular to and at one end of a spindle, which is attached through a spring to a turning-head. The torque on the rod due to the field to be measured is balanced by means of the head, the rotation of which gives a measure of the field-strength. The instrument is set with the rod in the position of maximum torque (at 45° to the field). A lower limit of field-strength measurable occurs where the field becomes comparable with the coercive force of the soft iron, but by suitable choice of rod dimensions and strength of spring, any field-strength greater than a few oersteds can be measured with an accuracy claimed to approach 1 part in 1000. C. E. W.

*5064. **Portable Direct-Reading Magnetometer. G. L. Turney and G. E. Cousins.** *Journ. Sci. Instruments*, 15. *pp.* 360–367, *Nov.*, 1938.—A portable magnetometer using a "null" method is described. The balance indication depends on the variation of the a.c. resistance of a high permeability mumetal wire in an external magnetic field. AUTHORS.

See also Abstracts 5031, 5074 and

3428B. Parameters of Surface Orthogonal to Eddying Magnetic Fields. T. Lehmann.
3434B. Design of Large Electromagnets. L. Dreyfus.

MEDICAL RADIOLOGY AND ELECTROLOGY.

5065. **Bioelectric Phenomena of the Nervous System and Their Possible Application to Medicine. A. Baudouin and H. Fischgold.** *J. de Radiologie et d'Électrologie*, 22. *pp.* 401–428, *Sept.*, 1938.—The phenomena of electrical changes in the nervous system are complex and a general review is given in the present paper, commencing from the early researches of Matteucci in 1840 and dealing with the difficulties of isolated research of muscular and nervous tissue. The basic principles of measurement of currents generated in nerves by their lesion or physiological action are detailed and then practical examinations of muscular, peripheral nerve and sympathetic nerves are discussed with illustrative instrumental readings. Further, more recent work in respect to brain tissue in various regions of the brain is dealt with at some length, particularly in respect to the electroencephalogram of Berger used in respect to the human brain, the electrodes being described in detail, with close discussion of the various types of record curves obtained under various conditions such as with drugs, alcohol and ether. The electrical variations in epilepsy which have been demonstrated by Berger are described and the electrical signs which assist diagnosis of this condition. The authors are of opinion that this method of investigation opens up a wide field of medical research and further practical clinical applications. B. J. L.

5066. Secondary Electromotive Phenomena of Nerve Tissue. A. Strohl and A. Djourno. *J. de Radiologie et d'Électrologie*, 22. *pp*. 481–489, *Oct.*, 1938.—Passage of d.c. *via* a segment of nerve tissue results in a distribution of potential in accordance with the electrotonic current. When this current is interrupted the potentials do not immediately revert to their initial value, there being a time lag which is considered to be due to secondary electromotive phenomena. This effect is studied by the authors in respect to current between conductive electrodes, the apparatus being described with galvanometer readings obtained by use of normal nerve, aged nerve tissue and nerve tissue submitted to the action of ether. The distribution of the secondary potential along the nerve is separately discussed. The phenomena are thought to originate from depolarisation effects. B. J. L.

***5067. Differential Amplifier for Electrophysiology and for Bridge Measurements. H. König.** *Helv. Phys. Acta*, 11. 6. *pp*. 507–512, 1938. *In German*.—A circuit without magnetic coupling which amplifies the p.d. between two electrodes independently of their absolute potential is described. The input voltages are fed through two valves in parallel to a 1- or 2-valve amplifier, giving an output circuit with one pole earthed. The amplifier can be used directly or in combination with a bridge circuit for electrophysiological measurements. The characteristics of the amplifier over a wide range of frequencies and for single impulses have been investigated. J. E. R.

5068. Radiographic Detail. F. Bettelheim. *Am. J. of Roentgenology and Radium Therapy*, 40. *pp*. 401–404, *Sept.*, 1938.—Reference is made to the fact that many radiographs taken after the discovery of X-rays 42 years ago compare, in respect to the visual impression, very favourably with modern radiographs. The photographic effect is dependent upon the absorption of the tissue radiographed. Whereas electroscopic measurements and mathematical calculations of the absorption of various human tissues would predict a radiographic differentiation of tissues, particularly in respect to soft tissues, in practice this is not the case. The three main factors are (1) composition of the X-ray beam, (2) the body tissues, and (3) the photosensitive layer. These various factors are discussed in detail and improvement in differentiation is considered to be obtainable by working with monochromatic radiation characteristic of a suitable anode material, choosing the longest wave-length suitable for the problem in question, using photosensitive material absorbing the remainder of the radiation spectrum, increasing the focus-object distance to reduce scattered radiation and non-use of intensifying screens. Experiments are being undertaken to prove or disprove these conclusions. B. J. L.

5069. Mechanism of Delayed Killing of Maize Seeds by X-Rays. L. R. Maxwell. *Nat. Acad. Sci., Proc.* 24. *pp*. 377–384, *Sept.*, 1938.—Biological response to X-rays has often been interpreted on the basis of the quantum theory of radiation absorption and the so-called hit theory of Glocker [see Abstract 792 (1933)], involving the concept of a particular sensitive volume within the material. The survival-dosage curves for single-celled individuals frequently show a simple exponential relationship. When multi-cellular systems are studied it is usually found that the survival curves have a sigmoid shape, indicating that either death occurs from a number of hits within one sensitive volume or a different number of hits within two or more sensitive volumes. This theory has been tested for corn seed embryos which are 7 mm. long, large enough for scanning purposes designed for the purpose of searching for the position of a possible single sensitive volume. A continuous band of radiation was used with a maximum intensity at 0·50 Å and a short wave-length limit of 0·26 Å with dosages ranging up to 300,000 röntgens, and scanning irradiation zones of 0·5-3·0 mm. width, defined by Pb plates. Experimental survival-ratio dosage relationships are shown, in which a sigmoid-shaped curve is obtained. A theoretical survival curve was made to fit the experimental curve by selecting 14 to be the number of penetrations by primary electrons and the spherical sensitive volume to be approximately 1×10^{-15} cm^3. on the basis of the use of monochromatic radiation of wave-length 0·50 Å which approximates to the average wave-length used. From a series of experiments it is concluded that if multiple sensitive volumes do exist, they are not contained within a spherical volume whose diameter is less than 0·5 mm. T. A. C.

5070. Radiation Protection. R. Jaeger and H. Stubbe. *Phys. Zeits.* 39. *pp.* 671–673, *Oct.* 1, 1938. *From the Reichsanstalt.*—In view of the now well established facts that the effects of X- and γ-rays on mutation rates are cumulative and irreversible, the question of the protection of medical and industrial radiologists is reviewed. The use of condenser ionisation chambers which can be carried by radiation workers, is advocated for protection purposes. The characteristics of the air-wall condenser chambers of Zimmer, which are suitable for this purpose, have been investigated. It is pointed out that a dose of 100 r. will double or treble the spontaneous mutation rate of *Drosophila melanogaster*. Workers subjected to the accepted tolerance dose rate of 0·25 r./day, would receive this dose in approximately 2 years, and it is suggested that the cumulative dose in a working life may be too large. Investigations have been carried out in a number of radiological institutions, and in some cases the daily dose received by workers was only 1/10 of the tolerance dose of 0·25 r./day. J. E. R.

***5071. Depth Doses from Teleradium Units. W. V. Mayneord and J. Honeyburne.** *Brit. J. of Radiology*, 11. *pp.* 741–753, *Nov.*, 1938. —An experimental teleradium unit is described, in which it is arranged that focal " skin " distance, thickness of filter and area of source, may be varied. It is shown experimentally that the amount of soft radiation at the aperture increases with focal " skin " distance, as does the percentage depth dose. Results of experiments with varying thicknesses of lead filter show that the first 0·5 mm. of lead, together with 0·6 mm. brass, produce the maximum improvement in depth dose. Varying the area of the source produces little difference in depth dose for large focal " skin " distances, but for smaller ones (2–3 cm.) increases the depth dose by some 20%. AUTHORS.

***5072. Dosage with Radium Surface Applicators of Small Area. J. E. Roberts.** *Brit. J. of Radiology*, 11. *pp.* 755–761, *Nov.*, 1938.—A number of physical problems which arise in the use of Ra surface applicators of small area are considered from the point of view of radium and radiation distribution. Depth dose curves show the advantages of the use of larger

Ra skin distances, the improvement being particularly marked at the edge of the applicator. The effects of errors in Ra distribution and Ra skin distance are indicated. With a view to overcoming some of the difficulties, specifications of a number of standard small applicators are given. AUTHOR.

***5073. Two-Gramme Radium Unit. F. L. Warburton.** *Brit. J. of Radiology*, 11. *pp.* 762–766, *Nov.*, 1938.—A description is given of a new appliance for the use of a 2 gm. Ra unit constructed largely of W-alloy. The unit is extremely flexible. Protection for the staff is provided by shutting off the beam in the unit itself when not in use. AUTHOR.

See also Abstract 4900.

OSCILLATIONS AND WAVES.

5074. Velocity of Propagation of Electric Waves along Nickel Wires and Magnetic Permeability of Nickel for Hertzian Oscillations. K. F. Lindman. *Zeits. f. techn. Physik*, 19. 10. *pp.* 323–324, 1938.—The difference between the velocity of light and the velocity of propagation of electric waves along Ni wires of 0·0172 mm. dia. is measured for wave-lengths from 15·8 to 86 cm. As the wave-length is increased up to about 50 cm. the difference rapidly increases but then approaches a constant difference of about 25000 km./sec., corresponding to a permeability of 19·9. The value for Fe at the same wave-length is about 100. [See also Abstract 3418 (1938).] H. J. H. S.

5075. Physics of the Upper Atmosphere. J. Zenneck. *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 1–37, 1938.—Review and Bibliography of the subject.

5076. Study of Magneto-Ionic Theory of Wave Propagation by Means of Simple Formulæ, Linkages and Graphical Devices. V. A. Bailey and J. M. Somerville. *Phil. Mag.* 26. *pp.* 888–905, *Nov.*, 1938. *Supplement*.—Methods are given for the rapid numerical determination of the polarisation R, refractive index μ, and absorption index χ of an electric wave in an ionised gaseous medium with a constant magnetic field present (*e.g.*, the ionosphere). First is given a scheme for the arithmetical computation of R, μ and χ. Next a simple linkage is described by means of which R can be determined in two settings. Finally it is shown how, when R is known, μ and χ can be determined by any one of the following means: (1) A special linkage; (2) a chart containing two families of circles and (say) three parabolæ; (3) a chart containing three families of circles. AUTHORS.

5077. Damping Coupling. G. Schmerwitz. *Ann. d. Physik*, 33. 2. *pp.* 107–108, *Sept.*, 1938.—The author refers to a previous paper [see Abstract 4906 (1937)] and to papers of K. W. Wagner on the same subject. He points out the differences between the cases taken by Wagner and that considered by himself. H. H. H.

See also Abstract 4849 and

3409B. Wavemeter. Y. Miyamura.
3575B. Unusual Range of Radio Signals. J. A. Pierce and H. R. Mimno.
3576B. Reflection Coefficients of Heaviside Layer. F. Vilbig.
3578B. Radio Transmission and Solar Activity. E. V. Appleton.
3589B. Forced Oscillations. F. Dacos.
3590B. Relaxation Oscillations. J. J. Muller.
3596B. Barkhausen Oscillations of Double Frequency. H. Mohr.

PHOTOELECTRICITY.

5078. Optical Properties and Photoelectric Emission in Thin Alkali Metal Films. H. E. Ives and H. B. Briggs. *J.O.S.A.* 28. *pp.* 330–338, *Sept.*, 1938.—Details are given of an experimental investigation undertaken to test a theory correlating the photoelectric emission of thin films of alkali metals with the optical properties of the alkali metals and the base on which they are deposited. The theory assumes that the photoelectric emission is proportional to the rate of absorption of energy in the top layer of the alkali metal film and when extended gives close agreement with experiment. The characteristic phenomena, *i.e.*, emission maxima occurring in the spectral response curves of photoelectric emission appearing only for light polarised in one plane, are explained in terms of the optical constants. A. H.

***5079. Accuracy of Rectifier-Photoelectric Cells. J. R. Atkinson. N. R. Campbell, E. H. Palmer and G. T. Winch.** *Phys. Soc., Proc.* 50, *pp.* 934–946, *Nov.* 1, 1938.—The effect of a resistance R in series with a rectifier-photo-cell on (*a*) the linearity of the response and (*b*) the temperature coefficient of the sensitivity has been investigated. In order that no restriction should be imposed on R by the effective sensitivity, the photoelectric current was measured by compensation. The light sources used in these experiments were tungsten-filament vacuum lamps operating at a colour temperature of approximately 2400° K. The temperature coefficient of the cell is always least when $R = 0$, but is not then generally zero. The approach to linearity is generally closest for a finite value of R which is usually between 100 and 1000 Ω. But no value of R will avoid errors of 1% if linearity is assumed over a range of 0 to 240 lux. The observations can be explained qualitatively, but not completely, by assuming the presence of a series resistance inside the cell in addition to the shunt resistance. These two resistances do not vary in the same manner with temperature and with illumination. Some practical conclusions are given in the final paragraph. AUTHORS.

See also Abstracts 4971, 5058.

PIEZOELECTRICITY.

5080. Survey of Piezoelectricity. W. G. Cady. *Am. Phys. Teacher*, 6. *pp.* 227–242, *Oct.*, 1938.—Gives the early history of the development of piezoelectricity. Mentions modern applications such as the piezoelectric resonator and oscillator. H. H. H.

5081. Anomalous Charging Current in Rochelle-Salt Crystals. F. Seidl. *Phys. Zeits.* 39. *pp.* 714–716, *Oct.* 15, 1938.—The anomalous charging current in Rochelle-salt crystals follows a law of the form $I(t) = k \cdot t^{-m}$ for short intervals of time t within the experimental limits of $2 \cdot 6 - 8 \cdot 1$ m.sec., the value of m being unity. For times of voltage application shorter than $2 \cdot 6$ m.sec. there is some divergence from this relation. Over the same interval, the current/voltage relation is linear, *i.e.*, in accordance with Ohm's law. The initial current depends on the thickness of the specimen. M. G. S.

THERMIONICS.

See Abstracts 5056, 5057.